Chapter 6 Cumulative Effects Analysis

This section evaluates the potential for cumulative effects as a result of implementing the Vegetation Treatment Program (VTP) or any of the program alternatives. The environmental setting for cumulative effects is described for each resource topic in Chapter 4. Combined with the impact evaluation in Chapter 5, these two chapters provide the foundation for the evaluation of potential cumulative effects.

6.0 Introduction

Defining the scope of a cumulative impact analysis is challenging, particularly for a statewide program, such as the VTP. Because the VTP is a statewide program, it can be argued that a large range of non-VTP projects, programs, and activities that occur throughout the state should be incorporated into the cumulative analysis of VTP because they affect resource conditions on a statewide basis. As examples, the resources of the state that are affected by the VTP (e.g., air and water quality, fish and wildlife population, public safety) are all affected by a wide range of non-VTP programs and actions including regulation of pollution control, water quality, timber harvest; city and county land use decisions; land management policies, plans, and on-the-ground projects; funding of resource protection and fire suppression activities, human population growth, and a host of other actions. The relevance of these other actions and the magnitude of their effects, relative to potential effects of the VTP, vary widely. Of these non-VTP activities, population growth in California, and the development patterns that result from it, may have the greatest affect on the condition of Forest and Rangelands (see Chapter 4*, Population and Housing*).

The strategy for defining an appropriate range of actions and conditions for the VTP cumulative analysis requires consideration of baseline conditions and projection of reasonably foreseeable related future actions. Recognizing that a broad range of activities can affect vegetation conditions, the VTP cumulative effects analysis has attempted to focus on those existing conditions and related programs that are similar to, or have similar effects as, the VTP.

The related programs considered for the VTP analysis for cumulative effects analysis for most resource programs includes:

- Vegetation and fuels treatment programs undertaken by federal land management agencies and other jurisdictions outside of the VTP
- Regulated timber harvest on state and private lands
- Timber harvest and other land management activities on federal lands

Certain other programs and actions related to certain resource conditions are included within the cumulative analysis for those resources, including:

- Water Quality: Regulatory programs governing water quality of the U.S. EPA and Regional Water Quality Control Boards
- Air Quality: California Air Resources Board

The cumulative effects (CE) analysis for the VTP Program EIR assesses effects at the program level. The following cumulative effects analysis evaluates the potential for positive and negative cumulative effects from the Proposed Program through direct and indirect effects on the individual resources discussed in Chapters 4 (*Regional Setting*) and 5 (*Environmental Impact Analysis and Mitigation*). It is possible for cumulative effects to occur locally, but not be detected at the broader spatial scales, and some local and regional effects will need to be addressed at the project level. Hence analysis at the project level will be conducted through the use of a checklist to be used as part of the environmental analysis for each VTP project. The programmatic CE analysis assumes project level environmental analysis, including CE analysis, for each VTP project.

In this chapter we address the cumulative effects by the resource topics presented in Chapter 5. We include additional information that is relevant specifically to cumulative effects to synthesize and clarify, rather than repeat in detail, information that is found in other parts of this EIR. Therefore, the following discussion of cumulative effects relies in part on the more detailed descriptions that are included in other sections of this EIR. References are provided to lead the reader to appropriate sections in the EIR and to other materials supporting points that are not described elsewhere in the EIR. For resource areas that were identified as areas of substantial public concern during the scoping process and for areas that were identified of substantial concern during the EIR analysis process, greater amounts of assessment and summary of information presented earlier are provided here. For resource areas of lesser concern, the presentation is briefer and simply refers to earlier sections that address cumulative effects issues.

The resource topic areas for which cumulative effects are specifically considered here include the categories of Watershed (with subcategories of Stream Flow Effects, Water Quality Effects [Sediment, Water Temperature, and Nutrient Effects]), Wildland Fire Risks, Hazardous Materials, Soil Productivity, Biological Resources (with subcategories of Aquatic Resources, Wildlife Resources and Botanical Resources), Recreation, Aesthetics, Noise, Transportation and Traffic, Air Quality, and Cultural Resources. The environmental setting for each resource topic is discussed in Chapter 4 and provides the context or baseline condition for evaluating cumulative effects.

6.1 Regulatory Framework

The CEQA Guidelines require that an EIR provide a discussion of cumulative effects, which is a change in the environment that results from adding the effect of the project to those effects of closely-related past, present and probable future projects. CEQA guidelines define cumulative effects as two or more individual effects which, when considered together, are considerable or which compound or increase other environmental effects (CEQA Guidelines § 15355). The effects may be changes resulting from a single project or a number of separate projects. The cumulative impact from several projects is the change in the environment that results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative effects can result from individually minor but collectively significant effects (CEQA Guidelines § 15355). In a CEQA evaluation, the proposed action must be considered with the combined effects of the cumulative actions in a single analysis. The effects from multiple projects may be additive or synergistic.

Regulatory and Planning Framework on Federal Lands

Through the implementation of the National Fire Plan and the Healthy Forests Restoration Act of 2003, federal agencies have been instructed to take more aggressive actions to reduce the risks of severe and catastrophic wildfire on public lands. Their goals and objectives are largely consistent with state Vegetation Treatment Program: to manage vegetation in a manner that reduces the threat of severe to catastrophic wildfire; to improve vegetation and habitat conditions for domestic animals and wildlife; and to improve fire protection for local communities. In addition to the above, the intent of these vegetation management activities is to help restore native vegetation to more natural fire regimes (i.e., more frequent low-intensity fires) and vegetative structural conditions closer to that which existed prior to large-scale settlement by Euro-Americans, (approximately pre-1850).

Vegetation management under federal agencies (e.g., BLM, NPS, and Forest Service) represents a similar set of actions as those proposed under the VTP. The recently completed EIS on BLM's revised Vegetation Treatment Program covers 17 western states, including the agency's holdings in California. In watersheds with both private and public lands, actions by federal agencies may occur near projects of the VTP.

In addition, other forms of vegetation management will also occur in these same watersheds from activities related to commercial timber production and livestock grazing, both on public and private lands. Pre-commercial thinning, selective harvesting, even-age management and other related actions all result in alterations of the natural vegetation and have bearing on the program's cumulative effects and the watershed's wildfire hazard, wildlife habitat and other resource issues.

Framework for Evaluating Cumulative Effects

The main goals of the California Statewide Vegetation Treatment Program (VTP), as described in Chapter 1, are to 1) lower the risk of catastrophic wildfires on nonfederal lands by reducing hazardous fuels (i.e., vegetation); 2) control unwanted vegetation, often noxious invasive weeds; 3) improve rangeland, and fish and wildlife habitat; and 4) protect riparian areas and wetlands. The focus of the cumulative effects analysis is the collective action of individual projects under the VTP when combined with related activities (timber harvest) on private lands and similar projects on federal lands.

Fuel reduction projects are conducted to reduce the threat of catastrophic wildfires. There is substantial evidence that after decades of effective fire suppression, many of California's forests have high accumulations of fuels and a dense forest stand structures that greatly increase the risk of high severity fires (see Section 4.2 *Wildfire Trends*). To address this risk, both state and federal agencies are increasing the number of fuel reduction projects with the objective of reducing the frequency of high severity wildfires. There are many different methods for fuel reduction, as described in the alternatives (Chapter 3), but the two most common methods are prescribed fire and mechanical removal of vegetation. Fuel reduction projects represent a relatively low intensity of disturbance, but to be effective in most cases will require repeated treatments into perpetuity (Ryan, 2006).

Temporal and Spatial Domain

The return interval needed for repeating vegetation treatment can vary from several years to several decades, depending on the vegetation type being treated (grassland, shrub, and forest), site conditions, and the pre-1850 mean fire return interval for the region. For example, in Sequoia-mixed conifer stands after 10 years the fuel load returned to about 83% of pre-burn levels (Stephens, 2006). The analysis period for the cumulative effects analysis covers a minimum of 10 years of prior management activity going back to 1997, and extends the planning horizon an additional 10 years to 2016.

The spatial domain for the VTP program is limited to State Responsibility Area (SRA) and Direct Protection Area (DPA) lands as described in the project description. In addition, the cumulative effects analysis considers effects from similar projects on federal lands. For cumulative watershed effects, the analysis considers any CALWATER planning watersheds with 2% or more SRA land (i.e., where CAL FIRE has jurisdiction).

6.2 Past, Present, and Future Projects

The CEQA Guidelines describes the “list” method of addressing cumulative effects wherein the assessment must include a listing of all relevant past, present, and reasonably probable foreseeable future projects. Under CEQA (21083) a project’s incremental effect must be viewed in combination with the effects of other relevant past, present, and reasonably foreseeable future projects. These project categories are presented below.

Table 6.2.1 provides a summary of vegetation management for CAL FIRE and federal agencies (National Park Service, US Forest Service, Bureau of Land Management, US Fish and Wildlife Service). Other agencies, local government, water districts, conservancies and actions by private landowner (outside of the VTP program) are also likely to conduct fuel reduction projects. However, this information is not available on a statewide basis and likely represents a minor contribution to the overall acreage treated and is not included here. Instead, as part of the project level checklist (see Chapter 8) each project will identify any known vegetation management projects that have recently occurred in the immediate planning watershed(s) for the proposed project.

Table 6.2.1
Average Annual Summary of Past Projects and Percentage of Disturbed Acres

Bioregion	Federal Fuel Reduction Projects	Timber Harvest All Lands	CFIP Projects	Past VTP Projects	Wildfire*	Sum of Current Disturbed Acres	Vegetation Acres Treatable	Percent Current Acres Disturbed
Bay Delta	1,278	3,124	128	763	15,119	13,779	2,890,535	0.48
Central Coast	5,845	0	9	3,425	106,578	16,293	7,048,246	0.23
Colorado	199	0	0	0	5,220	199	2,007,618	0.01
Modoc	23,690	26,266	113	175	109,649	52,063	4,827,095	1.08
Mojave	7,469	204	8	447	24,587	30,881	15,908,556	0.19
North Coast	38,349	58,673	260	355	27,719	105,099	11,386,915	0.92
Sacramento	20,773	0	71	3,034	6,357	59,843	6,393,568	0.94
San Joaquin	23,870	0	32	1,407	4,317	41,886	10,286,261	0.41
Sierra	58,945	64,502	986	1,123	104,279	139,276	15,668,458	0.89
South Coast	10,738	12	14	719	189,151	54,486	3,859,173	1.41
Total	**191,156**	**152,781**	**1,620**	**11,448**	**592,977**	**513,806**	**80,276,423**	**0.64**

* Wildfire acres based on data from 2001 – 2010.

6.2.1 Past Projects

The following section considers past projects that were funded by CAL FIRE for vegetation management and to the extent possible provides a summary of similar vegetation management projects that are being implemented on public lands in California by federal agencies. The categories of actions considered include: vegetation management, commercial timber harvesting and related activities, wildfire, and development. CEQA guidelines do not state a timeframe for listing past projects. For CAL FIRE funded projects this report documents projects within the last 10 years.

The Vegetation Management Program (VMP) is a cost-sharing program that focuses on the use of prescribed fire, and mechanical means, for mitigating wildland fire fuel hazards and other resource management issues on State Responsibility Area (SRA) lands. Implementation of VMP projects is by CAL FIRE units (Table 6.2.2). The projects fit within a unit's priority areas (e.g., those identified through the Fire Plan) and are considered to be of most value to the unit are those that will be completed.

Table 6.2.2 Acreage of VMP Projects per Year Listed by CAL FIRE Units											
BIOREGION	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
BAY / DELTA		930	2,097		807	960	1,295	2,011	3,001	216	2,839
CENTRAL COAST	1,573	4,385	2,562	1,521		4,412	1,617	573	2,949	3,275	487
COLORADO DESERT		423				25				96	
KLAMATH / NORTH COAST	873	673	771	487	335	188	765	416	29		474
MODOC		62	17	979		33	39				20
SACRAMENTO VALLEY			857	1,259		2,994	2,102	1,776	755		1,349
SAN JOAQUIN VALLEY				677							
SIERRA	6,232	2,199	3,449	53	1,123	509	928	1,105	464	357	269
SOUTH COAST	1,275	273		3,342	118	1,090	326	556	828	385	2,986
Grand Total	**9,953**	**8,945**	**9,754**	**8,319**	**2,382**	**10,210**	**7,072**	**6,437**	**8,025**	**4,329**	**8,424**

CAL FIRE also funds projects under the California Forest Improvement Program (CFIP). These projects can involve a range of activities that includes: tree planting, tree shelters, commercial thinning, pruning, release, site preparation, development of management plan, and land conservation activities for improving fish and wildlife habitat. For the purpose of analysis, only activities that can cause site disturbance (thinning, site preparation, and slash removal) were recorded in Table 6.2.3. The data report list projects from 2001 to 2010. CFIP projects are most heavily concentrated in the Sierra, Sacramento Valley, and North Coast bioregions. The projects tend to be small in size, averaging about 41 acres over the past 10 years. The largest CFIP project was 270 acres.

Table 6.2.3 Acreage of California Forest Improvement Program (CFIP) Projects per Year by Counties and Bioregions										
Bioregion	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
BAY/DELTA	62	1,005	1,737	764	5,109	1,195	167	1,706	0	0
KLAMATH / NORTH COAST	0	2,572	10,116	3,705	3,606	3,332	507	2,293	5,317	5,306
MODOC	0	122	4,581	697	2,314	1,051	758	84	0	0
SIERRA	321	5,359	891	10,201	12,523	2,031	2,193	9,128	1,387	1,387
SOUTH COAST	0	375	292	282	40	50	466	127	0	0
Statewide	**383**	**9,433**	**17,617**	**15,649**	**23,592**	**7,659**	**4,091**	**13,338**	**6,704**	**6,693**

The history of past VMP and other CAL FIRE projects establishes an environmental reference point or baseline for the proposed VTP program. On private lands, vegetation management has been limited, averaging 30,000 acres treated annually over the past 10 years. The average size of a VTP project is about 260 acres. The projects are focused mostly in the Sierra and Klamath/North Coast bioregions, but have not been locally concentrated within watersheds enough to expect significant effects. As a result of a relatively low level of vegetation management, the direct negative effects from past projects are likely to be minor. However, the low level of vegetation management when combined with fire suppression activities has increased the likelihood and risk of more frequent catastrophic wildfires, which may be having a long-term significant indirect negative impact on the environment.

Proposition 40 – Fuels Reduction Program

The California Clean Water, Clean Air, Safe Neighborhood Parks, and Coastal Protection Act (Proposition 40) of 2002, provided funding for CAL FIRE to implement a wildland fuels reduction program to reduce the risk of catastrophic wildfires in 15 Sierra Nevada counties: Butte, Plumas, Sierra, Yuba, Nevada, Placer, El Dorado, Amador, Alpine, Calaveras, Tuolumne, Madera, Mariposa, Fresno, and Tulare.

Related Past Projects

The following section describes related projects that are not part of the CAL FIRE's proposed VTP, but may produce similar environmental effects and have the potential when combined with activities proposed in the EIR to produce a cumulative effect.

Federal agencies conduct vegetation management projects on federal lands that are similar in purpose to the actions described in the proposed VTP. As the Forest Service and other natural resource agencies implement the National Fire Plan (USDA and USDI, 2012), the Healthy Forests Restoration Act (GAO, 1999; USDA and USDI, 2003) and the President's Healthy Forest Initiative (Dombeck et al., 2004; Graham et al., 2004; Stephens and Ruth, 2005), a substantial increase in fuel reduction projects and related activities has occurred in recent years and is likely to continue in the foreseeable future. Federal agencies report fuel treatment projects through NFPORS (National Fire Plan Operations and Reporting System). This information has been summarized to report on activities across the major Bioregions in California. See the National Fire Plan web site for additional information on federal projects: http://www.forestsandrangelands.gov/reports/index.shtml.

The USFS has provided information on fuel reduction projects in California from 2003 – 2010 (Table 6.2.4A-B). The information shows that over the past eight years the USFS has implemented fuel reduction projects on almost 2,000,000 acres of forest and rangeland, or roughly 235,000 acres on an annual basis. About two-thirds of the fuel reduction projects on federal lands used mechanical treatments and about one-third used fire.

Table 6.2.4A
Summary of Acres of Fuel Reduction Projects (Treatment - Fire) on Federal Lands, 2003 – 2010
Source: http://www.forestandrangelands.gov/resources/reports/index.shtml

Fire All	BIA	BLM	BOR	FWS	NPS	USFS	Grand Total
2003	36	1,757	-	28,414	13,038	50,044	93289
2004	980	1,893	-	25,175	6,054	48,816	82,918
2005	214	2,432	-	33,187	17,346	44,064	97,243
2006	361	4,214	-	26,021	15,688	42,942	89,226
2007	-	6,872	-	23,863	9,314	60,830	100,879
2008	-	1,729	-	22,735	10,602	36,200	71,266
2009	210	3,795	55	26,135	13,562	43,615	87,372
2010	35	2,163	-	25,506	10,050	38,955	76,709
Grand Total	**1,836**	**24,855**	**55**	**211,036**	**95,654**	**365,466**	**698,902**
Annual Avg.		**3,106.88**	**6.88**	**26,379.50**	**11,956.75**	**45,683.25**	**87,362.75**

Table 6.2.4B
Summary of Acres of Fuel Reduction Projects (Treatment - Mechanical) on Federal Lands, 2003 – 2010
Source: http://www.forestandrangelands.gov/resources/reports/index.shtml

Mech All	BIA	BLM	BOR	FWS	NPS	USFS	Grand Total
2003	1,839	12,502	-	11,564	3,635	34,160	63,700
2004	4,301	10,727	-	8,051	3,098	132,597	158,774
2005	2,449	21,196	-	2,856	4,793	104,014	135,308
2006	4,286	12,874	-	83,836	2,475	82,395	185,866
2007	3,390	14,950	-	11,268	1,874	112,327	143,809
2008	1,050	21,365	-	2,337	5,309	94,845	124,906
2009	3,306	13,490	-	50,362	3,852	156,969	227,979
2010	2,308	12,644	-	1,412	3,709	125,897	145,970
Grand Total	**22,929**	**119,748**	**-**	**171,686**	**28,745**	**843,204**	**1,186,312**
Annual Avg.	**2,866**	**14,969**	**-**	**21,461**	**3,593**	**105,401**	**148,289**

Timber Harvesting

Both commercial timber harvesting and fuel reduction projects result in the removal of vegetation cover and introduce some degree of site disturbance. Commercial timber harvesting is considered a more intensive form of vegetation management because it can result in complete vegetation removal from clear-cutting and other forms of even-aged management. Certain even-aged management prescriptions such as clear cutting and associated site preparation can result in nearly complete vegetation removal. Timber harvesting that involves thinning or selective harvests result in partial canopy removal, generally with less site disturbance, less erosion potential, and a lower potential for other water quality effects (Robichaud et al., 2010). Other research based on study sites in Oregon and

Montana have shown that observed and predicted erosion rates from timber harvesting or prescribed fire were much lower than erosion rates from wild fires (Elliot, 2002). Timber harvesting can increase sediment yields from surface erosion, but with revegetation, yields decrease over time at a negative exponential rate (National Council for Air and Stream Improvement, 1999). The road network needed to support timber management activities has been shown to be a more persistent and chronic source of sediment (Luce, 2005; MacDonald, 2010), suggesting that uneven-aged management can result in an increase in road use and a higher potential for surface erosion compared to even-aged management.

Timber harvesting contributes to the environmental background conditions that projects in VTP would operate under. Table 6.2.5A and Table 6.2.5B provide a summary of the extent of timber harvesting on public and private lands in California. Commercial timber harvesting mostly occurs in the Sierra, North Coast, and Modoc bioregions.

Table 6.2.5A
Acres of Commercial Timber Harvesting Activities on Private Lands, 2001-2010

		BAY / DELTA	CENTRAL	KLAMATH / NORTH	MODOC	MOJAVE	SIERRA	SOUTH	TOTAL
2001	Other	376	0	7,255	40	0	2,392	0	10,064
	Even-age	53	0	5,746		0	379	0	6,178
2002	Other	705	0	20,488	4,745	0	4,365	0	30,304
	Even-age	753	0	15,998	1,288	0	1,122	6	19,167
2003	Other	856	0	20,022	7,716	0	10,085	0	38,679
	Even-age	47	0	11,762	2,625	0	2,458	0	16,892
2004	Other	2,554	0	44,943	40,916	0	15,410	0	103,824
	Even-age	965	0	25,069	2,336	0	3,832	0	32,202
2005	Other	1,155	0	55,605	73,349	1,114	29,401	0	160,624
	Even-age		0	21,265	3,767	0	6,026	0	31,058
2006	Other	2,723	0	64,768	62,699	0	31,305	0	161,495
	Even-age	399	0	25,772	8,509	0	12,234	0	46,914
2007	Other	4,840		82,035	70,269	0	44,186	0	201,330
	Even-age	504	16	31,100	9,804	0	10,876	0	52,300
2008	Other	1,476	0	105,473	53,522	0	71,009	0	231,479
	Even-age	148	0	32,370	14,178	0	10,026	0	56,723
2009	Other	1,697	0	68,253	49,581	0	54,239	0	173,771
	Even-age	513	0	30,723	7,491	0	6,298	0	45,025
2010	Other	2,004	0	24,406	2,277	0	17,196	0	45,883
	Even-age	253	0	13,184	620	0	3,430	0	17,487
	Grand Total	**22,021**	**16**	**706,238**	**415,734**	**1,114**	**336,269**	**6**	**1,481,399**

Table 6.2.5B Acres of Commercial Timber Harvesting Activities on Federal and Private Lands, 1995 - 2005							
Bioregion	**USFS Even-Age**	**USFS Uneven-Age**	**USFS Total**	**Private Even-Age**	**Private Other**	**Private Total**	**Total Acres**
Bay Delta						31,246	31,246
North Coast	11,366	138,719	150,085			436,650	586,735
Modoc	1,936	134,116	136,051			126,617	262,668
Mojave	0	24	24			2,381	2,405
Sierra	50,553	341,632	392,185			252,839	645,024
South Coast	0	119	119			0	119
Total Acres	**63,854**	**633,054**	**678,463**			**849,732**	**1,528,195**

Wildfire

High severity wildfires represent one of the greatest forms of disturbance for a watershed. For example, the removal of vegetation, organic material, and changes to soil properties can greatly alter water infiltration rate (Martin, 2001; Neary et al., 2005). Studies have shown that severe wildfires in chaparral areas in southern California can produce water repellent soils (DeBano, 1981). Extensive and severe wildfires, such as those experienced in southern California watersheds in 2003, can dramatically alter the timing and distribution of sediment and water post-fire (CAL FIRE, 2003).

Section 4.2 (*Wildfire Trends*) describes the environmental conditions for wildfires across the state. An estimated 250,000 acres burn each year across California, but the year to year variability is high; Table 4.2.1 provides a summary by bioregion. The contribution of wildfire to cumulative effects is considered under Cumulative Effects to Water Resources (Section 6.4.1).

Development (AB 4290 “100 feet Clearance Rule”)

Development in California’s wildland areas has increased the risk and cost of fighting wildfires. Defensible space ordinances have been developed to reduce the risk of wildfire in the Wildland Urban Interface (WUI). The California State Board of Forestry and Fire Protection (Board) promulgated defensible space regulations necessary to implement under Senate Bill (SB) 1369 of 2004. This legislation amended PRC 4291 to, among other things, require persons in State Responsibility Area (SRA) to maintain additional fire protection around a structure by removing brush, flammable vegetation, or combustible growth that is located up to 100 feet from the building or to the property line.

The clearance rule represents a type of vegetation management conducted by individual landowners and concentrated in WUI areas across the state. The Board of Forestry and Fire Protection estimated the total number of structures within the State Responsibility Area (SRA) that are potentially affected by this regulation at 811,158. Table 6.2.6 provides an estimate of the number of structures affected for each Bioregion.

Table 6.2.6 Estimated Number of Structures for Different Housing Density Classes by Bioregion								
Density 1 structure per N acres	**None**	**160**	**40**	**20**	**10**	**5**	**1**	**Total**
North Coast	0	15155	9106	9143	12045	12211	35901	93559
Modoc	0	5975	3597	2773	2934	2212	7594	25084
Sacramento Valley	0	6718	6248	7051	12064	12026	33335	77441
Sierra Nevada	0	10857	11556	18017	27726	36325	81702	186184
Bay Area - Delta	0	6629	10910	12971	18061	28151	93385	170106
San Joaquin	0	9706	12539	16664	19139	16050	37717	111815
Central Coast	0	13189	6229	5099	7396	9123	29630	70667
Mojave	0	5449	4624	4527	6544	11657	37723	70524
South Coast	0	2736	6134	11706	18474	28258	155977	223285
Colorado Desert	0	3403	2227	2335	4113	3924	16132	32134
Total	**0**	**79817**	**73170**	**90287**	**128495**	**159936**	**529095**	**1060800**
Cumulative bin totals			**152987**	**243274**	**371769**	**531705**	**1060800**	

Grazing on Rangeland

Specific characteristics of rangelands are described in Chapter 4 (Section 4.1.3 *Range Setting*). This section describes more specifically those areas where grazing actually occurs, the amount of rangeland area available for grazing (available rangeland), and an estimate of the area actually grazed by livestock (grazing area). These metrics help define who owns rangelands, where rangelands are located, how they are managed and what portion of all rangelands are actually available and used for grazing livestock.

Ownership of rangeland types is not evenly distributed. A majority of Hardwood Woodland, Grassland, and Wetland habitats are privately owned. In contrast, a majority of Conifer Woodland, Shrub, Desert Shrub, and Desert Woodland habitats are publicly owned (see Table 4.1.3). The total amount of rangeland across California has been estimated at between 17.4 – 24.4 million acres on private land, and between 33.8 – 57.1 million acres on federal lands (Table 6.2.7). Rangelands are defined by having appropriate vegetation to support grazing, and not based on actual use by livestock (i.e., grazing area).

Table 6.2.7 Various Rangeland Area Estimates by Ownership (Million Acres)			
	Private	**Public**	**Total**
Primary rangelands (FRAP)*	24.4	32.7	57.1
Rangeland (NRI)**	18.3	***	18.3
Available rangeland (FRAP)	21.9	19.8	41.7
Grazing area (ERS and RPA****)	17.4	16.7	33.8

ERS – Economic Research Service; FRAP – Fire and Resource Assessment Program; NRI – National Resource Inventory; RPA – The Forest and Rangeland Renewable Resources Planning Act of 1974
*Excludes conifer forest types
**Excludes any hardwood or conifer forest types
***National Resources Inventory (NRI) measure some non-federal public lands but are included in private in this table
****RPA (Mitchell, 2000) estimates used to derive area on public land

Sources: Mitchell, 2000; FRAP, 1999; CAL FIRE, 2003b; NRCS, 2000; ERS, 2001

Grazing Area

The area of land in California that actually has grazing of livestock is termed “grazing area.” Field sampling conducted by the Natural Resources Conservation Service and allotment use records submitted by the Forest Service and BLM determine the amount of grazing area.

The USDA Economic Research Service (ERS) is the only federal group that measures the total land grazed across all ownerships throughout the State. More detailed estimates of federal grazing land by ownership are derived from Rangeland Resource Trends in the United States. (Mitchell, 2000) and are summarized in Federal Grazing Land (Table 6.2.8).

Table 6.2.8 Total Grazing Area in Range and Forest Categories in All Ownerships, 1997 (Million Acres)	
Type of grazing	**Acres**
Grassland and other pasture and range*	22.3
Forest land grazed**	11.8
Total grazing area	**34.1**

*Grassland and other non-forested pasture and range in farms plus estimates of open or non-forested grazing land not in farms; **Woodland grazed in farms (ERS, 2001)

These tables suggest several findings related to potential cumulative effects from grazing:

- When comparing grazing area (34.1 million acres) with primary rangelands (approximately 57 million acres), it appears that primary rangeland area far exceeds the land base actually grazed. This means that there is a substantial area of rangelands where there is inadequate forage or water to support livestock grazing, or grazing is not permitted and land is managed primarily for ecological values.
- A large proportion of available rangelands (82 percent or 34.1 million of 41.7 million acres) are already being grazed. On some of this land base the level of grazing is light, with few animals per acre. Overall, however, this means that there are limited opportunities for new grazing

activities -- especially when considering the on-going decline in the available rangeland base in California due to development and other pressures.

- On public lands, large areas are not available or used at minimum levels for grazing due to exclusion by administrative designations and relatively poor forage production. Approximately 17 million acres of the nearly 33 million acres of public primary rangelands are grazed (52 percent). Over half of the 17 million acres is in desert land cover types that produce little forage and are susceptible to environmental damage due to grazing.
- Private rangeland is used for grazing at a much higher level than public lands. Seventeen million of the 24 million acres of private primary rangeland is grazed (71 percent).
- The ecological implications of this use suggests that private rangeland is more widely used for grazing, in part because the lands are often more productive and better watered. To some degree this raises the risk of environmental concerns. Other implications are that public lands are more likely used for wildlife habitats for species not dependent on grazing, benefits of fire reduction due to grazing are likely better realized on private lands, and successional changes are more likely on public lands.

Findings on Forage Production, Grazing Capacity and Use

One method to assess the productive capacity of rangelands includes comparing the amount of vegetation available for grazing (forage production) and the extent to which this vegetation is used (use). However, direct estimates of rangeland forage are not comprehensively collected, unlike counterpart measurements for forests (standing board foot volume of forests and harvest levels). This deficiency limits a direct assessment of sustainable forage production and use.

Proxy methods must be used to assess forage production and use. Forage production estimates are made by estimating grazing capacity, the maximum stocking rate possible without inducing damage to vegetation or related resources, measured in animal unit months (AUMs) per acre by vegetation, ownership, and region. To measure use, FRAP uses the number of livestock (specifically beef cattle grazed on rangelands) to evaluate use from a commodity point of view (Mitchell, 2000). Estimates of forage use are derived by approximating the inventory of animals in California forage types.

Forage Types

Forest and rangelands provide forage (browse and non-woody plants) used for grazing by livestock and game. Forage varies in its quantity by species, time of year, and other factors such as climate, soils, and topography. Cattle consume a varied diet on rangeland that may include grasses, legumes, forbs, and brush (browse). The major land cover types provide varying amounts of forage and include Grassland, Wetland, Hardwood Woodland and Forest, Desert Shrub, Desert Woodland, Shrub, and to a lesser extent Conifer Woodland and Forest. Grasslands are the most important source of forage for California livestock (.75 – 1.5 AUMs).

Grazing Capacity Estimates

Landowners rely on forage that exists on both publicly and privately owned lands and in a variety of vegetation types. Forage is measured in the form of AUMs, the amount needed to sustain one mature cow and her calf, five sheep, or six deer for a month. An AUM is approximately 800 to 1,100 pounds of dry biomass, and represents the amount of forage that can be removed annually while still maintaining productivity. FRAP has not updated or designed an information system that evaluates forage production or estimates AUM usage since the 1989 Assessment. Because forage production may not be the critical limiting factor affecting rangeland productive capacity, it is unlikely that models supporting this dynamic will be extensively developed. Many other trends, particularly the declining land base and the presence of non-native, invasive species, are likely more important factors affecting long-term sustainability of rangeland productivity.

Previous assessments (CH2M HILL, 1989) have estimated the forage production for both primary rangelands and secondary lands (Conifer Forests) producing forage. In this assessment, grazing capacity is used to estimate the sustainable level of grazing which a vegetation type can support, not the actual annual growth of range biomass. Grazing capacity is defined as a stocking rate that is possible without inducing damage to vegetation or other resources. Over 14 million AUMS are produced on California's available primary rangelands (Figure 6.2.1 and Tables 6.2.9 and 6.2.10).

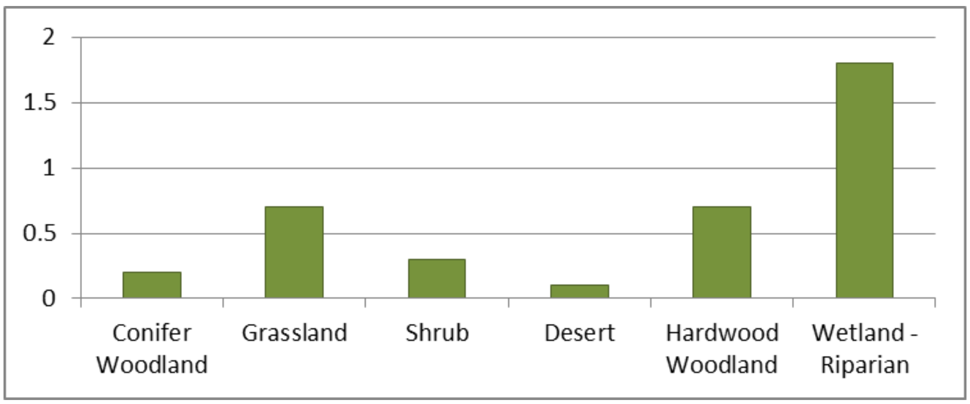

Figure 6.2.1 Average annual grazing capacity (AUM per acre) by primary rangeland cover class
*Includes montane riparian CWHR, valley foothill riparian CWHR, and wet meadow CWHR
Source: CAL FIRE, 2003b; CH2M HILL, 1989

Table 6.2.9
Total Annual Forage Production on Available Primary Rangelands by Land Cover Class

Land cover type	Grazing Capacity in AUMs per acre	Area (millions of acres)	Total AUMs (millions)
Conifer Woodland	0.2	1.6	0.4
Grassland	0.7	9.2	6.6
Shrub	0.3	11.6	3.4
Desert	<0.1	14.3	0.5
Hardwood Woodland	0.7	4.6	3.2
Wetland/Riparian*	1.8	0.4	0.8
Total	**0.4**	**41.7**	**14.8**

AUM – animal unit month
*Includes montane riparian CWHR, valley foothill riparian CWHR, and wet meadow CWHR
Source: CAL FIRE, 2003b; CH2M HILL, 1989

Table 6.2.10 Total Annual Forage Production on Available Secondary Rangelands by Land Cover Class			
Land cover type	**Grazing Capacity in AUMs per acre**	**Area (millions of acres)**	**Total AUMs (millions)**
Conifer Forest and. Montane Hardwood	0.04	19.1	0.8

Source: CAL FIRE, 2003b; CH2M HILL, 1989

Forage Use on Public Land

The use of forage on BLM and USFS lands is reported annually as the number of AUMs permitted in grazing districts or range allotments. As shown in Figures 6.2.2 and 6.2.3, permitted AUMs peaked in the 1980s and have steadily declined. This estimate suggests that less than one million AUMs come from use on federal lands. It also implies that the bulk of the estimated 11.8 AUMs used in California come from private lands even though the area grazed on public versus private land is nearly equal.

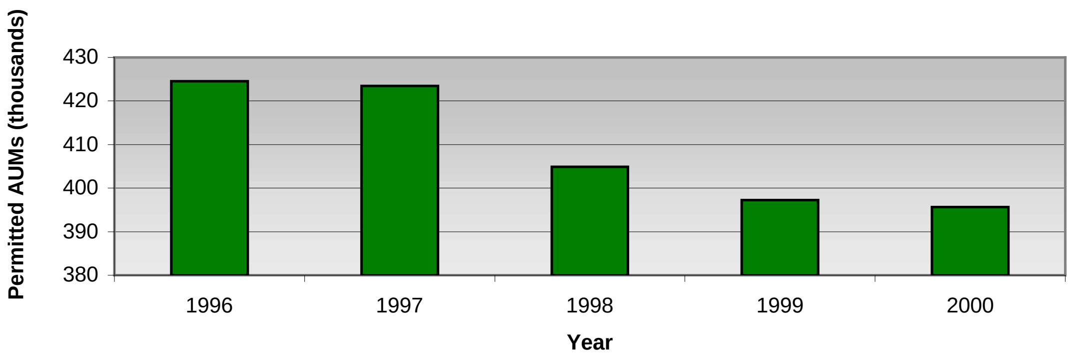

Figure 6.2.2 Number of AUMs on BLM lands with grazing permits and leases, 1996-2000

Source: Compiled by FRAP from USFS, 2002

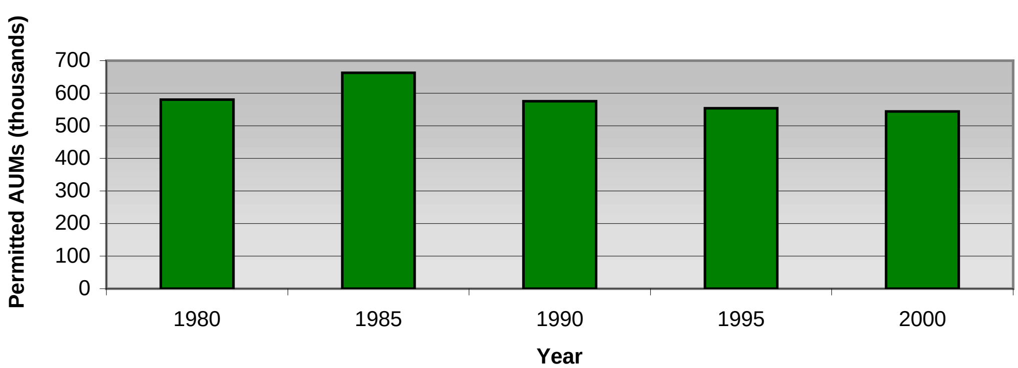

Figure 6.2.3 Number of AUMs on USFS lands with grazing permits, 1980-2000

<u>Comparisons of Forage Use and Grazing Capacity</u>

Grazing capacity on available rangelands in places exceeds the amount used for grazing of domestic livestock (Figure 6.2.4). However, excess forage for grazing may not be available because of the seasonal nature of forage availability resulting in ranchers seeking additional feed sources.

The current estimate of grazing capacity on rangelands available for grazing is 14.8 million AUMs. The majority of forage available for grazing exists in the Management Landscape class Working/Private/Sparsely Populated (10.8 million AUMs). Domestic livestock grazing use in all classes is estimated at 11.8 million AUMs based on the approximately two million head of cattle that periodically graze on private rangelands.

This profile suggests that at a broad statewide level, rangeland productivity is being maintained and lands are currently being grazed at a sustainable level. However, specific factors raise questions on the capability of California's rangelands to sustain grazing activities at this level in the future. These concerns include a declining rangeland area, encroachment of invasive non-native species, and grazing use reductions on public lands resulting in potential increased demand for grazing on private lands.

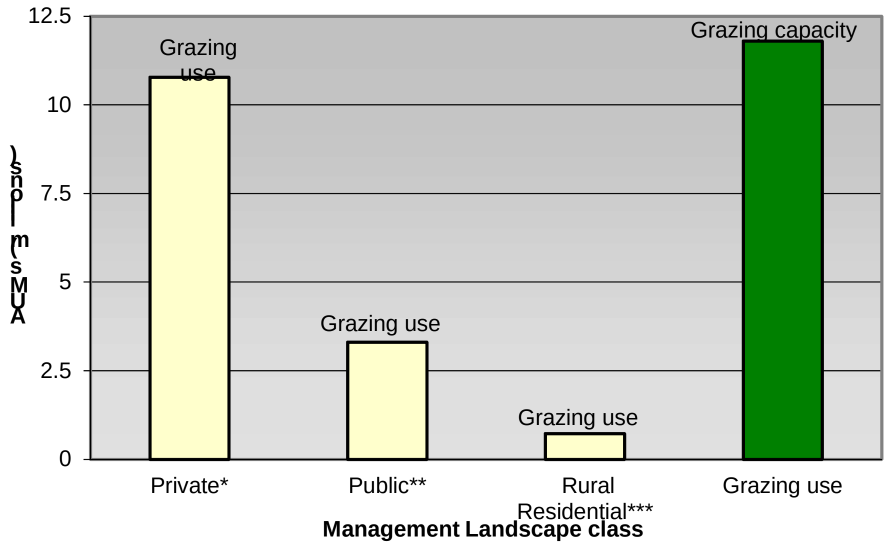

Figure 6.2.4 Grazing capacity by Management Landscape class and total grazing use, available rangelands

Source: CAL FIRE, 2003b; CH2M HILL, 1989; National Agriculture Statistics Service, 2001

<u>Summary of Past Projects</u>

Over the past 10 years CAL FIRE has implemented vegetation management projects on over 200,000 acres of land through VMP (195,000 ac), CFIP (16,200 ac), and Prop 40 (8,621ac). While there is substantial year to year variation the average annual treatment rate is 29,852 acres per year. The VMP projects are recorded by CAL FIRE Units, which cannot be directly compared to Bioregions. In general, the projects are broadly distributed across the state, with the greatest concentration in the Central Coast and within the Sierra Nevada.

Fuel reduction projects on federal lands have been much more extensive over roughly the same time period. Over the last 7 years, the USFS has implemented fuel reduction projects on approximately 850,000 acres. Other federal agencies (BLM, NPS, FWS, and BIA) have implemented projects on 300,000 acres since 2003. The combined total, roughly 1.15 million acres treated over the last seven years. The number acres treated by federal agencies has increased in recent years. Since 2003, the average annual treatment rate by federal agencies is 226,631 acres. Projects on federal lands were most heavily concentrated in the Sierra Nevada and Klamath / North Coast bioregions, with fewer projects in the Central Coast and South Coast bioregions. The combined average annual rate of fuel reduction projects (CAL FIRE and federal projects) is estimated at 194,852 acres per year over the last 10 years. During the last 4 years (2003 – 2006) the rate has increased to 256,483 acres per year.

Timber harvesting can be considered a related form of vegetation management. Timber harvesting was implemented on over 678,463 acres of federal lands and on over 849,732 acres of private lands over the last 10 years. These activities were concentrated in the Sierra Nevada and Klamath / North Coast bioregions. (see Table 6.2.11). The amount of timber harvesting also varies from year to year, but the average annual rate of timber harvesting can be estimated at 152,800 acres per year.

When past fuel reduction projects are combined with timber harvesting and other forms of vegetation management an estimate can be made of the percentage of landscape that is cumulatively disturbed by related activities. In all cases, less than 1.5% of the treatable vegetation in a given Bioregion is disturbed on an annual basis. While only a small proportion of a bioregion is treated in a given year projects that are concentrated in a more localized area (i.e. planning watershed) are much more likely to have cumulative effects that are detectable and potentially significant.

Table 6.2.11 Average Annual Summary of Past Projects and Percentage of Disturbed Acres								
Bioregion	Federal Fuel Reduction Projects	Timber Harvest All Lands	CFIP Projects	Past VTP Projects	Wildfire	Sum of Current Disturbed Acres	Vegetation Acres Treatable	Percent Current Acres Disturbed
Bay Delta	1,278	3,124	128	763	8,486	13,779	2,890,535	0.48
Central Coast	5,845	0	9	3,425	7,015	16,293	7,048,246	0.23
Colorado Desert	199	0	0	0	0	199	2,007,618	0.01
Modoc	23,690	26,266	113	175	1,819	52,063	4,827,095	1.08
Mojave	7,469	204	8	447	22,753	30,881	15,908,556	0.19
North Coast	38,349	58,673	260	355	7,462	105,099	11,386,915	0.92
Sacramento Valley	20,773	0	71	3,034	35,966	59,843	6,393,568	0.94
San Joaquin Valley	23,870	0	32	1,407	16,577	41,886	10,286,261	0.41
Sierra	58,945	64,502	986	1,123	13,720	139,276	15,668,458	0.89
South Coast	10,738	12	14	719	43,003	54,486	3,859,173	1.41
Total	**191,156**	**152,781**	**1,620**	**11,448**	**156,801**	**513,806**	**80,276,423**	**0.64**

6.2.2 Current Projects

Current projects include vegetation management projects funded by CAL FIRE under Proposition 40 (Table 6.2.12). These are mostly fuel reduction projects, but include other vegetation management objectives as well (Table 6.2.13). Some of these projects may have been completed, but most are currently being implemented, are on-going, or otherwise considered in progress. The cumulative effects analysis recognizes that similar actions on federal lands are also current and on-going, but very little information was available on their status. The databases on federal fuel reduction projects under report both the likely number of current and future projects.

Table 6.2.12 Total Acreage of Projects Funded Under Proposition 40 per Year by Unit				
CAL FIRE Unit	**2004**	**2005**	**2006**	**Total**
Amador- El dorado	3,315	6,239	1,345	10,898
Butte	495	2,393	537	3,424
Fresno-Kings	208	470	185	863
Madera-Mariposa-Merced	693	2,857	109	3,659
Nevada - Yuba - Placer	16,315	18,164	3,802	38,281
Sacramento Headquarters	0	0	0	0
Tuolumne - Calaveras	5,265	7,198	718	13,181
Tulare			290	290
Total	**26,289**	**37,321**	**6,986**	**70,596**

Counties include: Alpine, Amador, Butte, Calaveras, El Dorado, Fresno, Madera, Mariposa , Nevada, Placer, Plumas, Sacramento, Sierra, Tulare, Tuolumne and Yuba

Table 6.2.13 Total Acreages of Projects Funded Under Proposition 40 by Project Objective							
County	Forest Health Protection	Forest Restoration	Fuel Reduction	Other	Shaded Fuel Break	Watershed Protection	Total
Alpine						30	30
Amador	37		66			639	742
Butte		109	372		44		525
Calaveras			287			317	604
El Dorado		169	487		1212	1123	2746
Fresno		42				208	250
Madera			144			433	577
Mariposa			246				246
Nevada			4528		47		4575
Placer			976		40		1016
Sacramento				100			100
Sierra			140				140
Tuolumne		143	226		55	645	1069
Yuba			522		40		562
Total	**37**	**463**	**7994**	**100**	**1438**	**3395**	**13427**

Timber harvesting is also an on-going related activity. Current timber harvesting is based on Timber Harvesting Plans (THPs) submitted and approved on non-federal lands, but not yet completed. The North Coast has the greatest THP acres in this status (298,226 ac), followed by the Sierras (173,250 ac), Modoc (50,036 ac), and the Bay Area (19,422 ac). Since THP operations can be postponed until the end of the third year (with extension for time), the estimate represents a three year time frame.

Forage Use

Forage use is estimated indirectly by evaluating the inventory of beef cattle in a particular year and then calculating the AUMs needed to support that inventory. In 1997, nearly 1.9 million head of cattle were grazed annually for some period on primary and secondary rangelands (National Agriculture Statistics Service, 2001). To estimate the amount of forage used by these animals, the number of months used for range grazing must be estimated (see AUM Use Calculation). Using this methodology, it is estimated that over 11.8 million AUMs per year are consumed on California rangelands. For more information on the cattle inventory, see the Fire and Resource Assessment chapter on Range Livestock Industry (CAL FIRE, 2003).

6.2.3 Future Projects

Future projects in CEQA are defined in the CEQA Guidelines (15130, subsection (b)(1)(B)) as projects for which an application has been received at the time the notice of preparation is released. This would include projects that are planned to occur in the near future, but are not currently implemented.

While individual VTP projects may show little signs of disturbance, collectively fuel reduction projects and related vegetation management activities by State and Federal agencies could potentially lead to larger scale environmental effects. As described in Chapter 2 (pg 2-24), the VTP expects at most to implement projects on between 1,000,000 to 2,500,000 acres over a 10 year period. This estimate represents a maximum level of activity to be expected under future projects (Table 6.2.14). On federal lands, future planned fuel reduction projects listed in the National Fire Plan database are reported as less than 10,000 acres for 2007. This is very likely an underestimate. Data from the National Fire Plan shows that in recent years federal agencies have been implementing fuel reduction projects on roughly 225,000 acres in California per year. With an average of 30,000 acres treated annually through CAL FIRE, the combined disturbance from vegetation management covers an estimated 255,000 acres annually. This represents a baseline condition. The collective State and Federal actions in the future are likely to result in as much as 300,000 to 450,000 acres of wildland vegetation treated annually. These projects can occur in locations across the entire state, but are mainly concentrated in forest and range settings. California supports approximately 31 million acres of forest land and 57 million acres of primary rangelands (CAL FIRE, 2003; 2010). The combined or cumulative actions of fuel reduction projects on private and federal lands statewide would result in vegetation treatments between 0.45% - 0.64% of the landscape per year. Table 6.2.14 shows the expected acres treated if the VTP program treated about 217,000 acres on average annually over a ten-year period, and federal programs continued to operate at their current rate over the next 10 years. The actual percentage of the landscape that is disturbed does not reflect recovery rates and is likely to be less than the amount shown.

Table 6.2.14
Expected Acres Treated on Federal and Private Lands Over a 10 Year Time Frame (2007 – 2016)

Bioregion Name	Bioregion Size (acres)	Vegetation Acres Treatable	Fed-RX Fire (acres)	Fed-Mecha-nical (acres)	Fed-Bio-logical (acres)	Fed-Prep (acres)	Fed-Total (acres)	CAL FIRE Acres Proposed for treatment	Total (acres)	% Dis-turbed
Bay Delta	6,287,849	2,890,535	4,395	14,600	170	13	19,178	156,000	174,658	6.0
Central Coast	7,986,038	7,048,246	30,495	16,805	12,629	59	59,987	380,000	439,847	6.2
Colorado Desert	6,756,990	2,007,618	1,878	1,063	50	-	2,990	72,600	75,270	3.7
Modoc	8,332,063	4,827,095	81,395	125,266	223	5,758	212,641	223,200	435,841	9.0
Mojave	19,937,290	15,908,556	1,465	6,663	300	-	8,428	20,000	18,048	0.1
North Coast	14,383,125	11,386,915	328,796	124,318	-	3,224	456,338	253,500	709,578	6.2
Sacrament o Valley	3,952,761	6,393,568	120,794	71,908	21,707	229	214,638	312,000	526,638	8.2
San Joaquin	8,224,210	10,286,261	190,726	69,728	2,679	15	263,148	117,100	379,888	3.7
Sierra	18,303,438	15,668,458	210,156	323,319	16,416	1,747	551,638	429,100	980,898	6.3
South Coast	7,281,899	3,859,173	19,904	91,605	55	125	111,689	205,600	286,929	7.4
Total	**101,445,664**	**80,276,423**	**990,004**	**845,274**	**54,228**	**11,169**	**1,900,675**	**2,169,100**	**4,027,595**	**5.0**

Note: For federal lands the predictions are based on historical data. The average annual acres treated was calculated from historical data and extrapolated over a 10-year planning horizon.

6.3 Watershed Potential Benefit and Constraints GIS Model (Future Condition)

In support of the PEIR, we performed a Geographic Information System (GIS) based analysis to map areas eligible for VTP projects, to highlight those watersheds: 1) of greater potential program need of vegetation and fuels treatments; and 2) where certain treatment practices (prescribed burning) may be constrained due to other considerations in the landscape (see Appendix A). Potential treatment need was based on the relative concentrations of both natural and development-related assets in the watershed that would benefit from the program (structures, timber, water quality, etc.). Potential treatment constraints were mapped with respect to the particular practices (prescribed burning, mechanical treatment, etc.) of the program. Available spatial data from various sources (mostly CAL FIRE) was synthesized into watershed-based evaluations of wildfire hazard, landscape values at risk (socio-economic, natural/cultural resource) and constraints using objective logic developed by CAL FIRE staff. The resultant maps provide a view as to how the program could allocate and help prioritize program vegetation treatment projects according to their relative need and potential benefit. The GIS constraints model can serve as a guide for implementing VTP programs. For a more detailed explanation of this analysis, see Appendix A.

6.4 Cumulative Effects Evaluation by Resource Topic

The following section discusses the potential for cumulative effects for the following resource topics (see Chapters 4 and 5 for additional information on each resource topic):

- Water Resources (Quality and Quantity)
- Geology and Soils
- Wildfire Severity and Extent
- Air Quality
- Archaeological and Cultural Resources
- Visual / Aesthetic Resources
- Noise
- Transportation
- Population and Housing
- Recreation Resources
- Biological Resources

6.4.1 Cumulative Effects – Water Resources

This section analyzes the potential cumulative effects to water resources, peak flows and water quality (including herbicides), due to implementing either the Proposed Program or any of the Alternatives. Section 5.7 contains an evaluation of program level effects to water and water quality that is also relevant to considering potential cumulative effects.

Significance Criteria

The following is a subset of the criteria presented in Section 5.7 (*Effects of Program/Alternative Implementation on Water Resources Including Water Quantity and Water Quality by Hydrologic Regio*n) and is used here to evaluate potential cumulative effects to water resources.

a) Violate any water quality standards or waste discharge requirements;
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (i.e., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted);

c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
e) Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff;
f) Otherwise substantially degrade water quality.

Determination Threshold

There is substantial scientific uncertainty on the magnitude and the duration of vegetation treatment effects on water resources. As such, there are no clear quantitative thresholds available; instead the following narrative thresholds were used (see Section 5.7.2):

1) A significant degradation of water quality;
2) Violations of Regional Water Quality Control Board Basin Plan objectives;
3) Significant impact on a beneficial use; or
4) Significant impact on runoff and or water yield.

Impact Evaluation (Background)

The environmental setting for water resources is described in Chapter 4 (Section 4.7). For most watersheds in California, fire is a dominate process that influences the timing and delivery of water, sediment, and nutrients throughout a watershed. Wildfires occur naturally in watersheds and their effect can be thought of as an episodic event. The recovery of environmental processes following a wildfire is dependent on the magnitude of the fire event. The recovery of ecological processes can be a long-term process, but many processes related to sediment and nutrients show major recovery within three to five years. In addition, the current condition for many watersheds involves chronic disturbances from a broad range of management activities (roads, development, land conversion, urban expansion, dams and water diversions, etc.), and fuel treatments represent an incremental short-term disturbance to the watershed.

Forested watersheds in California provide an important source of clean water for environmental, urban, and agricultural uses. In an undisturbed or minimally disturbed watershed, forest vegetation provides for high infiltration rates that reduces erosion and lowers sediment yields (Robichaud, 2000). By altering infiltration rates, fuel reduction and related vegetation management activities have the potential to increase runoff and increase sediment yields.

Section 303(d) of the Clean Water Act requires states to identify impaired waterbodies, and through TMDLs, identify pollutant sources and load allocations (Figure 6.4.1). This listing represents a process for understanding which watersheds are currently impaired and where VTP projects have the potential to incrementally contribute to water quality impairments. Table 6.4.1 summarizes waterbodies with known impairments for sediment, water temperature and nutrients. The North Coast and Central Coast regions have the greatest number of waterbodies that are listed as sediment or temperature impaired. Only a few watersheds in the Sierra are listed for sediment (e.g., Truckee, Walker). Nutrient impairments are more commonly found in many bioregions (Sacramento, San Joaquin, Central Coast), but most commonly associated with agricultural activities in lower valleys and not typically associated with forest management activities. Water quality impairment from pesticides occurs most frequently in the Central Valley, Central Coast, and San Diego water board regions.

Figure 6.4.1 2010 303(d) listed impaired waterbodies

Table 6.4.1
Summary Of 303(d) Listed Waterbodies by Hydrologic Region
(See WWW.SWRCB.CA.GOV for Most Current Listing)

Region	Sediment Impaired	Temperature Impaired	Nutrient Impaired	Pesticide Impaired
North Coast	Eel, Elk, Freshwater, Noyo, Big, Ten Mile, Navarro, Jacoby, Gualala, Garcia, Scott, Van Duzen, Redwood, Mad, Russian, Mattole, Lower Klamath, Trinity, Redwood Creek, Mad, Klamath, Bodega Estuary	Mattole, Eel, Klamath, Mad, Big, Noyo, Albion, Garcia, Gualala, Navarro, Ten Mile, Redwood, Russian, Trinity, Scott, Mad,	Eel, Russian, Klamath, Bodega Estuary, Bodega Estuary	
San Francisco Bay	Walker Creek, Lagunitas Creek, Napa River, Pescadero Creek, Petaluma River, San Francisquito Creek, San Gregorio Creek, Sonoma Creek, Tomales Bay, Butano Creek	Arroyo Mocho, Codornices Creek, Stevens Creek, Suisun Creek	Arroy Las Positas, Lagunitas Creek, Mission Creek, Napa River, Petaluma, Sonoma, Suisun Creek, Tomales Bay, Walker Creek	
Central Coast	Aptos, Bean, Bear, Boulder, Bradley Canyon, Branciforte, Carbonera, Carnadero, Carneros, Chorro, Chualar, Corralitos, Casmalia, Elkhorn Slough, Fall, Furlong, Gabilan, Greene Valley, Kings, Llagas, Los Osos, Love, Morro Bay, Moss Landing, Mountain Charlie Gulch, Natividad, Newell, Old Salinas, Orcutt, Pacheco, Pajaro, Prefumo, Quail, Rider, Rincon, Rodeo, Salinas, San Benito, San Juan, San Lorenzo, San Vicente, Santa Maria, Santa Ynez, Shingle Mill, Shuman, Soquel,Valencia, Zayante	Arroyo Seco, Atascadero, Chualar, Cieneguitas, Greene Valley, Llagas, Millers, Natividad, Orcutt, Quail, Salinas, San Miguelito, San Pedro, Santa Rosa, Santa Ynez, Uvas	Carbonera, Carpinteria, Chorro, Llagas, Lompico, Los Osos, Old Salinas, Pajaro, Salinas, San Lorenzo, San Luis Obispo, Schwan, Shingle, Tembladero	Blanco, Elkhorn Slough, Espinos, Moro Cojo, Moss Landing, Old Salinas, Tembladero, Watsonville Slough
Los Angeles	Calleguas, Las Virgenes, Malibu, Medea, Triunfo Canyon		Las Virgenes, Los Angeles, Malibu	Palo Verde Beach - Shoreline
Central Valley	Fall, Humbug, Panoche	Pitt, Feather North Fork, Pitt, Yuba, Willow Creek	Bear Creek, Butte Slough, Lower Calaveras, French Camp, Fresno, Honcut, Kellog, Lone Tree, Los Banos, Old, Pit, Pleasant Grove, Sand, Spring, Temple	Arcade, Bear, Berenda, Calaveras, Comanche, Coon, Curry, Deadman, Del Puerto, Dry, Duck, Elbow, Elder, Elk Bayou, Elk Grove, Feather, Ingram, Kaseberg, Kings, Lone Tree, Lower Merced, Miles, Mokelumne, Morrison, Mustang, Old, Orestimba, Sacramento, San Joaquin, Sand, Spring, Stony, Tuolumne, Ulatis
Lahontan	Bronco, Clearwater, Squaw, Truckee, Ward, Wolf, Blackwood, Walker, Gray, Heavenly, Hot Springs, Susan, Wolf Creek		Blackwood, Carson, Cold, General, Heavenly Valley, Hilton, Sheep, Susan, Swauger, Trout, Truckee, Ward	
Colorado River	Alamo, Imperial Valley Drains, New River		New River	Alamo, Coachella, Imperial , New River, Palo Verde Lagoon
Santa Ana	Rathbone		Chino, Grout, Mill, Rathbone, Summit	San Diego Creek
San Diego	Tijuana River		Aqua Hedionda, Aliso, Buena, Chollas, Cloverdale, Escondido, Murrieta, Rainbow, San Diego, Santa Margarita, Sweetwater, Tecolote, Tijuana, Warm Springs	Arroyo Trabuco, Buena, Chollas, Cottonwood, English, Escondido, Long Canyon, Murrieta, Redhawk, San Juan, San Marcos, Santa Gertrudis, Temecula, Tijuana River, Warm Springs

Cumulative Effects Analysis

ERA Impact Evaluation

Effects of the VTP program on water resources (water quantity and water quality) were evaluated in Section 5.7 using a modified form of the Equivalent Roaded Area (ERA) method. As described in Section 5.7.3, the ERA method was limited to analysis of treatments within the VTP program area and did not consider the cumulative effect of disturbance from other activities in a watershed. To examine potential cumulative effects the ERA method was expanded to include timber harvesting, roads, and fuel reduction projects on federal lands. The ERA analysis was applied to watersheds where VTP projects are likely to occur. For each watershed an ERA value is calculated as follows:

$$ERA = \left(\left(\sum_{p=1}^{5}\sum_{t=1}^{3}\sum_{r=1}^{2} A_{ptr} * E_{ptr}\right)/W\right) * 100$$ where:

A = acres treated
E = ERA coefficient
W = total planning watershed area
p = treatment practice (p = (1 = prescribed burning; 2 = mechanical; 3 = manual; 4 = herbicide; 5 = grazing)
t = time since disturbance (t = (1 = 1 year; 2 = 5 years; 3 = 10 years)
r = fire regime (r = (1 = surface; 2 = crown)

The ERA methodology is a disturbance index method that the US Forest Service developed for California; calculations result in an index of the activity level in a watershed (Reid, 2010). It is a "lumped, conceptual model that quantifies total disturbance in the watershed through the use of empirical coefficients and recovery curves for each activity (MacDonald et al., 2004)." The primary limitations of the ERA model are: 1) it does not separate effects on sedimentation from peak flows; 2) evaluation of recovery time is linked to causes of the effects rather than the effects themselves; 3) results are not spatially explicit (location of the project in the watershed, including and especially proximity to streams, is not accounted for); 4) ERA describes a level of risk due to management activities but does not offer an index of actual effects; and (5) there is no assurance that a single screening tool can adequately address multiple, unrelated impact mechanisms (Menning et.al., 1996; MacDonald et al., 2004; Reid, 2010). Additionally, climatic variability can mask linkage between hillslope activities and stream channel response (McGurk and Fong, 1995). Despite these shortcomings, ERA has been used since the 1980's in California (primarily on National Forest timberlands) as a quantitative accounting procedure for estimating potential effects of management activities on water quality and peak flows (Menning et al, 1996.). The ERA index assumes that the potential for impacts from cumulative effects increases with the intensity of land use disturbance within a given watershed.

The ERA method includes the concept of a "Threshold of Concern" (TOC) for each watershed, which is an estimate of the maximum amount of disturbance in a watershed that can occur without initiating adverse water quality or peak flow effects. The statewide TOC of 10-14% was used as a threshold to determine if effects are detectable and potentially significant. Distinct TOCs for geographic regions and/or specific beneficial uses of water are preferred, however, over statewide average values (McGurk and Fong, 1995).

Cumulative Effects Analysis

The ERA results for the VTP program alone are presented in Section 5.7. The ERA values in Section 5.7 are based solely on the estimated disturbance associated with the Proposed Program and the alternatives. To address potential cumulative watershed effects, ERA values were estimated that include the VTP program and other land use activities and forms of disturbance including: timber harvesting, roads, fuel reduction projects on federal lands, and wildfires. Statewide 98% of the Calwater planning watersheds had an ERA that was estimated below an ERA threshold of 10%. About one percent of the Calwater planning watersheds had an ERA value that was well above the threshold (15-20%). The ERA calculation provides a rough index for cumulative effects, but likely underestimates disturbance in most watersheds. This is due in part to limitations in data available for a statewide analysis and other forms of disturbance that may occur in a watershed, but for which statewide GIS data was not readily available (e.g., mining, development and land conversion).

Also, it is important to note that the US Forest Service developed the ERA methodology so that second and third order watersheds would generally be evaluated for project planning, while larger fourth and fifth order watersheds (planning watersheds or larger) would be evaluated for forest planning. Haskins (1987) suggested that second and third order (500 to 2000 acre) watersheds be evaluated with the ERA methodology, stating that if the size of the watershed is too large, the effects of clumping of activities into a subwatershed within it will not show up in the analysis. Carlson and Christiansen (1993) state that the planning watershed is used as the first level of examination to give a landscape level analysis with the ERA methodology, but that planning watersheds may need to be further subdivided depending on the number and location of projects and the geomorphology of the area. Therefore, the analysis provided in this document is to be considered as a landscape level analysis.

The data were also analyzed by Bioregion (Table 6.4.2A-F). Under baseline conditions, with the exception of the South Coast bioregion, most bioregions have a very small number of watersheds with ERA values above the 10% threshold. Under the Proposed Program the most noticeable changes in ERA values are for the Sacramento Valley and the South Coast bioregions. Alternatives 2 and 3 also show substantial increases in ERA values above the 10% threshold for the Sacramento Valley, while Alternatives 1 and 4 show only minor changes. This is in part an artifact of the small number of watersheds delineated for the Sacramento Valley Bioregion and reflects the historical placement of fuel treatment projects (i.e., large areas of prescribed burns in grasslands). The Proposed Program, Alternatives 2 and 3, all show a moderate increase in ERA values above 10% for the Sacramento Valley and South Coast Bioregions.

The analysis of 5,600 planning watersheds in the VTP program area estimates that 98% of the watersheds have an ERA value of less than 10%. The addition of the VTP program resulted in about 0.5% of the watersheds in the program area moving above an ERA threshold of 10%. Alternatives 2 and 3 resulted in the greatest number of watersheds shifting above a threshold ERA value of 10%, but this was still a small number of watersheds (e.g. less than 40 planning watersheds) compared to the total number watersheds across the program area (e.g. 5,600). Given the assumptions and limitations in the data and analysis methods (see Section 5.7.3), the relative size of the VTP program is small and it is unlikely that the addition of the VTP program will create a significant adverse cumulative effect or further degrade a watershed that is currently impaired.

Table 6.4.2A
Baseline ERA Values: Percent of Watersheds in Each Bioregion That Fall Into ERA* Disturbance Categories

Bioregion	Equivalent Roaded Acre Values per Watershed After 10 Years				
	0-1%	1-2%	2-5%	5-10%	>10%
Bay Delta	29	64	5	1	0
Central Coast	55	34	4	3	4
Colorado Desert	82	16	3	0	0
Modoc	15	70	11	2	2
Mojave	37	51	8	2	1
North Coast	93	3	1	0	3
Sacramento Valley	90	8	0	0	1
San Joaquin	95	5	1	0	0
Sierra Nevada	30	61	5	2	2
South Coast	15	46	22	10	6
Average	**54**	**36**	**6**	**2**	**2**

*Note: The ERA values represent conditions prior to the Proposed Program or alternatives

Table 6.4.2B
ERA Cumulative Effects: Percent of Watersheds in Each Bioregion That Fall Into ERA* Disturbance Categories for the Proposed Program and Other Non-VTP Sources

	Equivalent Roaded Acre Values per Watershed After 10 Years				
	0-1%	1-2%	2-5%	5-10%	>10%
Bay Delta	18	71	9	1	0
Central Coast	27	54	11	3	4
Colorado Desert	63	18	16	3	0
Modoc	12	71	13	2	2
Mojave	35	53	9	2	1
North Coast	92	3	1	0	3
Sacramento Valley	27	30	17	13	14
San Joaquin	63	21	11	3	1
Sierra Nevada	20	67	9	2	2
South Coast	9	40	26	15	9
Average	**37**	**43**	**12**	**4**	**4**

Note: The ERA values for Cumulative Effects considers disturbance from both VTP and non-VTP sources and the range of values differs from the results in Table 5.7.4.

Table 6.4.2C
Era Cumulative Effects: Alternative 1- Percent of Watersheds in Each Bioregion that Fall Into ERA* Disturbance Categories for the Proposed Program and Other Non-VTP Sources

Bioregion	Equivalent Roaded Acre Values per Watershed After 10 Years				
	0-1%	1-2%	2-5%	5-10%	>10%
Bay Delta	24	67	7	1	0
Central Coast	43	44	6	3	4
Colorado Desert	68	24	8	0	0
Modoc	15	70	11	2	2
Mojave	37	51	8	2	1
North Coast	93	3	1	0	3
Sacramento Valley	48	38	7	6	1
San Joaquin	76	22	2	1	0
Sierra Nevada	27	64	6	2	2
South Coast	12	45	25	11	7
Average	**44**	**43**	**8**	**3**	**2**

Note: The ERA values for Cumulative Effects considers disturbance from both VTP and non-VTP sources and the range of values differs from the results in Table 5.7.4.

Table 6.4.2D
Era Cumulative Effects: Alternative 2- Percent of Watersheds In Each Bioregion That Fall Into ERA* Disturbance Categories for the Proposed Program and other Non-VTP Sources

Bioregion	Equivalent Roaded Acre Values per Watershed After 10 Years				
	0-1%	1-2%	2-5%	5-10%	>10%
Bay Delta	16	72	9	1	1
Central Coast	25	56	11	4	4
Colorado Desert	61	21	16	3	0
Modoc	11	72	13	2	2
Mojave	34	54	9	2	1
North Coast	92	4	1	0	3
Sacramento Valley	24	30	21	8	17
San Joaquin	60	23	10	5	2
Sierra Nevada	21	67	9	2	2
South Coast	10	38	28	15	9
Average	**35**	**44**	**13**	**4**	**4**

Note: The ERA values for Cumulative Effects considers disturbance from both VTP and non-VTP sources and the range of values differs from the results in Table 5.7.4.

Table 6.4.2E ERA Cumulative Effects: Alternative 3 -- Percent of Watersheds in Each Bioregion That Fall Into ERA* Disturbance Categories for the Proposed Program and Other Non-VTP Sources					
Bioregion	Equivalent Roaded Acre Values per Watershed After 10 Years				
	0-1%	1-2%	2-5%	5-10%	>10%
Bay Delta	16	72	10	1	0
Central Coast	25	57	11	3	4
Colorado Desert	58	24	13	5	0
Modoc	11	71	13	2	2
Mojave	34	54	9	2	1
North Coast	91	4	1	0	3
Sacramento Valley	28	27	17	15	13
San Joaquin	62	22	11	3	2
Sierra Nevada	20	67	9	2	2
South Coast	10	37	29	15	9
Average	**36**	**44**	**12**	**5**	**4**

Note: The ERA values for Cumulative Effects considers disturbance from both VTP and non-VTP sources and the range of values differs from the results in Table 5.7.4.

Table 6.4.2F ERA Cumulative Effects: Alternative 4 - Percent of Watersheds in Each Bioregion That Fall Into ERA* Disturbance Categories for the Proposed Program and Other Non-VTP Sources					
Bioregion	Equivalent Roaded Acre Values per Watershed After 10 Years				
	0-1%	1-2%	2-5%	5-10%	>10%
Bay Delta	23	69	7	1	0
Central Coast	41	47	6	3	4
Colorado Desert	68	26	5	0	0
Modoc	14	70	11	2	2
Mojave	36	52	9	2	1
North Coast	92	4	1	0	3
Sacramento Valley	37	42	14	4	3
San Joaquin	73	23	3	1	0
Sierra Nevada	26	64	6	2	2
South Coast	13	41	26	12	7
Average	**42**	**44**	**9**	**3**	**2**

Note: The ERA values for Cumulative Effects considers disturbance from both VTP and non-VTP sources and the range of values differs from the results in Table 5.7.4.

Cumulative Effects Analysis

Determination of Significance

Impact A: Substantially alters runoff and water yield (threshold 4)
- Less than significant

The environmental effects of removal of vegetation for fuel reduction has received limited study to date. See Elliot et al., (2010) for a comprehensive review of existing information on the subject. A thinning for fuel reduction could be considered comparable to a heavy single tree selection harvest and less intensive than a clear cut. Studies have shown no measurable increase in runoff from thinning operations that remove less than 15 percent of forest cover, in areas with less than 18" of annual precipitation, and that measurable increases in runoff typically persist for less than 10 years (Robichaud, 2005; MacDonald and Stednick, 2003). In addition, the ERA analysis estimates that 97% of the watersheds will experience only a slight change in the amount of area disturbed (i.e., addition of ERA < 2% due to the VTP) as a result of implementing the proposed VTP program. Given the limited extent of the VTP program and the expected intensity of disturbance, it is unlikely that the VTP program will result in significant impacts to runoff and water yield at the planning watershed scale. Note, however, that flow effects are considerably more pronounced and easier to detect in small headwater basins (e.g., second order) when compared to the much larger planning watershed scale (typically fourth order) (Ziemer and Lisle, 1998). Thus, there is greater likelihood of measurable impacts to occur in small headwater basins.

Impact B: Substantially degrades water quality (no impact with mitigation) (thresholds 1 – 3)
- Less than significant with mitigations

- *Water quality parameters include: sediment, temperature, nutrients, and herbicides.* Mechanical Treatments (Thinning) and Prescribed Burning

As is the case with timber harvesting, removal of vegetation for fuel reduction requires access, often to vehicles and heavy equipment. For commercial timber operations, road construction and the legacy of extensive road networks has a pronounced effect on erosion and sediment yields. However, VTP projects will only use existing roads, as no program funding is available for new road construction. Typically, the degree of ground disturbance is minor and depending on the method should not result in extensive exposure of bare soil. Simulation models in forest settings predicted higher sediment yields from wildfires than from management activities (Elliot, 2002). Wildfires tend to be episodic in occurrence while management related sediment sources are typically chronic. As new vegetation grows back the erosion impacts from individual fuel treatments are likely to be short term. However, the cumulative effect of fuel treatments, repeated every 10-20 years, when combined with the impacts of road maintenance and use, could be similar to the pulse impact from wildfire (Robichaud et al., 2010). Based on the location of existing sediment-impaired watersheds, sediment and erosion are most likely to be widespread issues for projects in the North Coast bioregion and for selected watersheds in the Sierra and South Coast bioregions, particularly those with erodible soil types (e.g., decomposed granitic soil).

The removal of organic material from prescribed burning has the potential to disturb soil and generate soil erosion. This is dependent both on the intensity of the fire and the moisture conditions of the material being consumed. Prescribed burns are designed to produce low severity fires that remove litter while retaining the organic material in the upper soil layers. With low severity fires under typical prescribed burns, the potential for increased peak flows or increased erosion rates is relatively small (Robichaud et al., 2010). Alternative 4 (Air Quality) greatly restricts prescribed burning and is the least likely to contribute to cumulative effects that are associated with prescribed burning.

Herbicides – Potential Cumulative Effects on Water Quality

Herbicide use by the proposed VTP program and similar projects on federal lands represents a potential cumulative effect to water quality. The VTP program does not call for the direct use of herbicides in or near waterbodies. However, through erosion processes the potential exists for herbicides, attached to soils particles, to be transported into streams or other waterbodies. The likelihood of herbicides being transported through surface runoff to streams varies with distance from stream, soil infiltration rate, rate of surface flow, and adsorptive characteristics of surface materials (Brown, 1980). The active ingredients of the most commonly used herbicides in the VTP (see Chapters 4 and 5 for detailed discussion) are not considered highly toxic to fish, amphibians, and wildlife (see Section 5.17). However, it is possible that effects could be concentrated at a local level, in watersheds that are targeted as high priority for treatment, or in watersheds where there are significant federal lands with similar treatment activities occurring. With the exception of the Alternative 3 (no herbicide use) and Alternative 1 (No Project), all other alternatives (Program and Alternatives 2, 4, and 5) expect some herbicide use as part of the program.

The expected contribution of the proposed VTP program to the total amount of pesticides used in California is quite small. In 2005, Department of Pesticide Regulation (DPR) reported total pesticide use at 194,320,983 pounds. The use of herbicides on private forest lands accounts for 213,752 pounds, or less than 1% of the total. This was applied at an average rate of 1.4 lbs per acre (DPR, 2005). As described in Section 5.17, the VTP program would use herbicides on up to 19,620 acres annually (Table 5.17.3). If applied at an average rate of 1.4 lbs per acre that would result in an additional 24,500 pounds of herbicides being applied annually, adding 11.5% to the total amount of herbicides used on forest lands and adding 0.0126% to the total pesticide use statewide. Given the limited use of herbicides, less than 1% of total pesticide use statewide, the Proposed Program and the alternatives are not expected to have a significant effect on water quality from herbicide use. Alternative 3 is the “No Herbicide” alternative and as such would have the least impact.

In addition, as stated in Section 5.7, the vast majority of watersheds (96-99%) across the state will receive so few VTP projects (< 3 in ten years), combined with minimal ground disturbance from treatment methods, that water quality effects are unlikely. The cumulative effect of multiple projects (VTP and non-VTP) in a single watershed is not likely to be intensive enough to substantially impact runoff, water yield, or water quality. The analysis of 5,600 planning watersheds in the VTP program area estimates that 93% of the watersheds have an ERA value of less than 10%. Statewide, the addition of the VTP program resulted in about 5% of the total planning watersheds in the program area to move above an ERA threshold of 10%. At a bioregional level, the Sacramento Valley was the only bioregion where the implementation of the program, or alternatives 2 and 3, would shift a substantial number of watersheds beyond a 10% ERA threshold. Potential cumulative effects in this bioregion can be minimized by following the mitigations, minimum management requirements, and avoiding a high concentration of fuel treatment projects in any one planning watershed, or subwatershed within a planning watershed. The cumulative effect of fuel treatments are related to their location and concentration within a given second or third order sub-basin, as well as the degree and frequency of disturbance for each activity.

Thus given the limitations in the data and analysis methods (see Section 5.7.3), the relative size of the VTP program is small and it is unlikely that the addition of the VTP program will create a cumulative effect or further degrade a watershed that is currently impaired. With the mitigations measures stated in Section 5.7.9 any cumulative effect to runoff or water yield and water quality should be less than significant.

Comparison of Alternatives

The Proposed Program and Alternative 2 have similar effects to water quality. Both expect to treat on average 217,000 acres annually per decade and have a comparable proportion of treatment methods (Table 3.11) (with the exception that under Alternative 2, where there is no use of herbicides). Alternative 3 is designed to offer the greatest protection to water quality. Under alternative 3 the program would also operate with a cap of 217,000 acres average per decade, but the stream buffer widths are increased to be equivalent to those in the California Forest Practice Rules. In addition, under Alternative 3 treatments would not be applied on areas where the post-treatment Erosion Hazard Rating (EHR) would be high. Alternative 1 and Alternative 4 offer the least protection for water quality. Alternative 1 is the status quo and the program would operate without the additional protections as stated in the MMRs. Under Alternative 4 the program would treat fewer acres (93,000), but the use of mechanical treatments as the predominant method for vegetation management would likely result in greater effects to water quality through increased site disturbance.

Mitigation(s)

Impact A: Substantially alters runoff, water yield, or water quality

<u>Cumulative Equivalent Roaded Acres (CERA) watershed disturbance screening</u>

For each VTP project, the calculated Cumulative Equivalent Roaded Acres (CERA) will be used as a screening tool to determine the likelihood of cumulative impacts that are associated with land disturbance, both from the VTP project and other forms of land disturbance in the planning watershed. This approach uses a modified version of the ERA methodology to produce a disturbance index. The intent of the index is to identify planning watersheds where previous treatments or other forms of land disturbance have been concentrated. Depending on the number, size, and location of past projects in second and third order sub-watersheds and the geomorphic sensitivity of the landscape, additional consultation with hydrologists, geologists, or other resource specialists may be needed and CERA may be required to be calculated at the sub-watershed scale. The box and procedure shown below is included in the environmental checklist.

Cumulative Effects Analysis

Cumulative Equivalent Roaded Acres Calculation Procedure outline:

1) Calculate and sum raw ERA acres of four types of existing disturbance (other VTP projects; timber harvests; high intensity crown fires; development) that have occurred in the planning watershed over the past 5 years;
2) Convert into a percentage ERA subtotal by dividing total by the area of the planning watershed;
3) Add ERA percentage contributed by roads and proposed VTP project to get Total ERA

Within the same planning watershed, put in estimated total acres over the last 5 years, of:

	Acres		raw ERA
a. Other VTP projects	_______	* 0.15	= ________
b. Timber harvest	_______	* 0.20	= ________
c. High intensity or Crown wildfires	_______	* 0.30	= ________
d. Development (of >20% impervious surface area)	_______	* 0.50	= ________
e. Subtotal acreage of a. through d.			= ________
f. Total acreage of planning watershed			= ________
g. Subtotal Percent ERA (divide f. by e., mult. by 100)			**= ________**

h. Enter value for approximate road density** (miles/(sq mi)) in planning watershed:

0 – 3	1.7%	
3 – 7	4.0%	
7+	5.7%	= ________

i. Current VTP project ERA in % (from Mit. Meas. 5.7-1) = ________

j. Total estimated planning watershed Percent ERA
(Cumulative ERA = sum of g., h. and i.) =________

ERA disturbance coefficients for a., b., c., d., and h. were generalized and adapted from Menning et al., 1996.
**Road density ERA based on average road width of 30 feet.

CERA Evaluation

A cumulative ERA (CERA) of less than 10% will not require further analysis with reference to this mitigation, unless consultation with resource specialists regarding past project number, size, and location in sensitive sub-basins dictates that further analysis is required, including possible CERA calculation at the sub-watershed scale.

For CERA values from 10% to 13%, the project documentation will provide a brief discussion of how resources in the planning watershed may be impacted by the project and related activities and any actions being taken to reduce environmental impacts:

- watershed resources (sediment, hydrology, water temperature, soil productivity)
- biological resources (presence of threatened or endangered species, wildlife or habitat issues)
- visual and recreational resources

Further analysis will be required if consultation with resource specialists regarding past project number, size, and location in sensitive sub-basins dictates that further analysis is required, including possible CERA calculation at the sub-watershed scale.

For projects where the computed CERA exceeds 13% after project implementation, the project proponent will have to quantitatively “predict” potential impacts and “verify” that actual impacts did not exceed projected impacts through monitoring. Prediction could be based on extrapolation of empirical data (i.e., sediment budgets or studies of similar treatments in similar settings), modeling (e.g., WEPP FuME, SEDMODL2), or calculating a specific ERA using a smaller sub-basin of the larger planning watershed (i.e., second or third order watershed). Verification can be based on checklist type hillslope monitoring, recording physical evidence of rilling, gullying or sediment delivery at the project site after 1 or 2 winters and reporting results to CAL FIRE. Without pre-project data, water column monitoring is not likely to be feasible or useful, and is not recommended.

Other Water Quality Mitigations

Based on the underlying soils and geology, some watersheds are more sensitive than others to ground disturbance. Mitigation measures and management requirements presented in Section 5.7 are designed to reduce water quality effects and are also effective in reducing cumulative effects to water quality. Minimum Management Requirements (MMRs) included in the VTP include provisions that are designed to moderate potential effects to water quality. The MMRs establish minimum buffers on each side of Class I and II watercourses, from which heavy equipment is excluded and disturbance of vegetation providing shade to the stream is prevented. There are also provisions to restrict operation of heavy equipment on known or potentially unstable areas or saturated soils.

To avoid significant cumulative effects from the use of herbicides in the Proposed Program or the program alternatives, the VTP program will adopt mitigations discussed in Chapter 5 and implement project level monitoring as discussed in Chapter 7. The use of buffers, Minimum Management Requirements, and landscape constraints are anticipated to reduce effects to a less than significant level.

Landscape Constraints and Minimum Management Requirements place restrictions on operating in riparian areas on Class I and Class II watercourses. The following constraints will further reduce the likelihood of cumulative effects to water quality.

Landscape Constraints – specific to water quality

Landscape constraints 1, 2, and 3 are designed to protect water quality and act to constrain treatments from sensitive landscapes. See Chapter 2, Section 2.2 for additional information.

1. A watercourse or lake protection zone (WLPZ) will be established on each side of all Class I and II watercourses (see Glossary for definitions) that is equal to the widths specified in the CA Forest Practice Rules, which vary between 75-150 feet on each side of Class I watercourses and from 50-100 feet on each side of Class II watercourses. WLPZs are measured by slope distance from the high water mark of the watercourse. Vegetation significant to maintenance of watercourse shade will not be disturbed within Class I and II watercourses. Vegetation within and adjacent to Class III watercourses will be retained, as feasible, to protect water quality.

2. Heavy earth-moving equipment will not operate within the WLPZ of any Class I or II watercourse, as indicated above (50 feet for all projects except CFIP projects) except at existing or designated crossings. An exception to this practice may be allowed when conducting fish and wildlife habitat

improvement or forestland conservation projects (see 3, below). Wider protection zones may be required on some sites if so indicated by environmental review of the project.

3. Treatment of wet meadows, marshes, vernal pools, and other wet areas, as well as the use of wet areas as natural barriers for containing prescribed fire, are permitted when such projects will result in improvement of habitat for native plant and/or animal species. Necessary measures to minimize damage to wetlands will be incorporated into each such project.

Minimum Management Requirements – specific to water quality

See Chapter 2, Section 2.3 for additional information on Minimum Management Requirements.

1. No tractors, trucks, cars, or other machinery will be serviced adjacent to lakes or watercourses, or within wet meadows and other wet areas, or in other areas where such servicing could allow grease, oil, fuel, or other toxic substances to enter lakes, watercourses, or wet areas.

2. Heavy equipment will not operate on soils that are saturated. This means that equipment will not operate when soils are sufficiently wet that heavy equipment operations displace soils in amounts sufficient to cause a visible increase in turbidity to Class I, II, III, or IV waters or turbidity increases which would violate applicable water quality requirements.

3. When drafting water from waterbodies containing special status fish, reptiles and amphibians (e.g. for standby firefighting equipment for prescribed fire, for watering roads, etc.) the applicants' operations will generally conform to the current CA Forest Practice Rules for water drafting, at 14 CCR 916.9(r) [936.9(r), 956.9(r)].

6.4.2 Cumulative Effects – Soils and Geology

This section summarizes potential cumulative effects to soils and to geology due to implementing either the Proposed Program or any of the alternatives.

Significance Criteria

The same criteria used in Section 5.15 (*Soils and Geology*) is used to evaluate potential cumulative effects to soils and geology:

a) Soil erosion rates, loss of topsoil, or soil quality;
b) Exposure of people or structures to the risk of loss, injury, or death involving landslides;
c) In a geologic unit or soil that is unstable, or that would become unstable as a result of the Program or Alternatives, and potentially result in on- or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse.

Thresholds of Determination

The Program and Alternatives are considered to create a significant effect when a treatment or treatments causes:

Cumulative effects on geologic hazards and soils from the program or any alternatives were considered significant if proposed treatments would:

- substantially increase mass wasting in the form of landslides or other geologic hazards;

- substantially increase soil erosion rates; or
- substantially reduce soil productivity.

Impact Evaluation

Cumulative effects to soils on private and public lands currently exist throughout the state from different types of land disturbance including: site disturbance (natural or anthropogenic); resource extraction (e.g., mining); livestock grazing; road construction; timber harvesting; wildfires; recreational activities; agriculture; and development. In addition, an increased frequency of high severity wildfires may also affect soil productivity through the loss of ground cover and accelerated post-fire erosion rates (Moody and Martin, 2001).

The removal of biomass associated with fuel reduction projects can affect soil temperature and moisture, pH, organic matter, nutrients available for plant use, and susceptibility to erosion. Cumulative effects that occur in soils as a result of fire can manifest in significant changes in soil physical, chemical, or biological properties (Neary et al., 2005). Both wildfires and prescribed fires can result in increased soil exposure through partial or full removal of the vegetative canopy. Fires can cause nutrients to be lost from the site, either as gases or as part of the smoke. The weight and vibration from ground-based equipment can compact the soil, which can result in reduced water infiltration, reduced aeration, reduced root penetration, increased overland flow, and increased erosion (Page-Dumroese et al., 2010). Thinning of a Lake Tahoe Basin stand using a masticator revealed that there was no significant difference in soil compaction for 13 of 15 comparisons of soil profile resistance values at several distances from the machine track (Hatchett et al., 2006). While research is limited, mastication appears to be an effective thinning treatment for overstocked Lake Tahoe Basin timber stands with few negative impacts on soil compaction or soil erosion (Hatchett et al., 2006). In general, the magnitude of any soil changes increases with increased frequency and intensity of disturbance.

Impacts from Mechanical Treatments

Fuel reduction activities under the Vegetation Treatment Program are likely to involve repeated entries into forest stands or repeated burns to maintain fuel loads at a desired level over time. The use of heavy mechanical equipment to make multiple entries, as well as associated road maintenance and use, has the potential to generate impacts through site compaction and erosion (Robichaud et al., 2010). In watersheds with mixed private and federal ownership there may be a cumulative impact from similar activities taking place on federal lands. As described in Curran et al., (2005), multiple stand entries over time can increase soil impacts so that cumulative effects at the stand and watershed scale become significant.

The repeated entries that are needed to maintain desired fuel loads have the potential to produce cumulative effects through soil compaction, growing space loss, surface soil loss, and loss of organic matter. Site conditions are highly variable, making it difficult to assess impacts through a programmatic document. The development of BMPs is likely the best strategy for avoiding cumulative effects and protecting soil productivity for a program of this size and scope.

Cumulative Effects Analysis

Impacts for Prescribed Burning

Impacts from prescribed burning can vary from beneficial to negative depending on the severity of the burn. In addition to the surface temperature of the fire, the transfer of heat into the soil column also varies with the duration of exposure, soil water content, and soil pore distribution (Wohlgemuth, 2006). Hatten et al., (2005) conducted a study in Ponderosa Pine / Douglas-fir forests in Washington State and found no significant differences in soil properties for unburned versus low severity burned sites. The authors state that, "a low severity prescribed fire, if similar to a lightning-strike fire, is likely to have little direct effect on the soils' physical and chemical properties, suggesting that little effort will be needed for below ground restoration as long as efforts are made to minimize indirect effects on the soil."

The impact of prescribed burning on soil properties and nutrient dynamics has been studied in mixed conifer forests adjacent to Sequoia National Park. Research has shown that a large proportion of forest nutrients are retained in the litter (Stohlgren, 1988b). These nutrients are unavailable to plants until the litter is broken down and the nutrient elements are mineralized, which can occur through the action of soil organisms, or fire. St. John and Rundel (1976) determined that fire in the Sierra Nevada sequoia-mixed conifer forest caused a significant decrease in nitrogen, carbon, and cation exchange capacity, and a significant increase in phosphorus, calcium, magnesium, potassium, and pH. These authors concluded that fire was an effective mineralizing agent, and that despite the loss of some nutrients, fire generally enhanced the short-term nutritional environment for plants. The impact of fire may differ for other components of the soil. While studies conducted to date are limited, recent research has shown that prescribed fire in the Lake Tahoe basin had no effect on soluble reactive phosphate and only minimal effects on nitrate in stream waters (Stephens et al., 2005). An additional study found prescribed burning to result in a net decrease of inorganic N and P concentrations in surface runoff at a site near North Lake Tahoe (Loupe et al., 2007).

Neary et al., (2005) developed a conceptual model representing watershed response along a continuum of low to high fire severity. In this model prescribed burning typically occurs under conditions with lower air temperature, higher relative humidity, higher soil moisture and variable fuel loadings. These conditions are expected to have lower fire intensities and result in less damage to soil and water resources. For example, in chaparral, sediment yields after moderate severity prescribed fires have been reported as generating approximately 10% of the sediment yields generated after high severity wildfires (Meixner and Wohlgemuth, 2004).

Hydrophobic Soils

Under certain conditions high severity fires can promote hydrophobic soils that greatly restrict water infiltration. This layer is impermeable and prevents water from reaching all but the first few inches of soil, but at the same time slows the process of evaporation in the root zone. The extent and depth of a hydrophobic layer will depend upon the type of soil present. Relatively dense clay soils tend to resist this condition; however, sandy and sandy loam soils appear to be far more susceptible to hydrophobic conditions (DeBano, 1987). Prescribed burning prescriptions typically are successful at keeping severity low enough to prevent formation of hydrophobic soils (DeBano, 1989).

The depth at which these hydrophobic layers form is further the result of such factors as fire intensity, and the content of soil moisture levels (DeBano, 1987). The chaparral ecosystems in

Southern California are where these conditions are most likely to occur. Under these conditions water quickly saturates the thin layer of permeable soil above the hydrophobic zone not being slowed by a vegetative canopy. Slower infiltration rates result in an increased intensity of surface runoff and soil erosion. While hydrophobic soils affect watershed function, more recent research has shown that: 1) post-fire sediment yields are primarily due to the loss of surface cover rather than fire-enhanced soil water repellency; 2) surface cover is important because it inhibits soil sealing; and 3) the presence of ash temporarily prevents soil sealing and reduces post-fire runoff and sediment yields (Larsen et al., 2009).

Nutrient Cycling

Nitrogen is often a limiting factor in plant growth. During wildfires nitrogen is released. The amount of nitrogen released is greatly influenced by the maximum surface temperatures associated with a wildfire. At higher temperatures nitrogen becomes volatized and escapes in gaseous forms. For prescribed burns, where temperatures remain low (seldom producing temperatures exceeding 200 ^{o}F), the release of nitrogen may encourage plant growth (Neary et al., 2005).

A recent study in Ponderosa pine forests of Montana found that increasing nitrogen heterogeneity increased plant diversity (Gundale, 2006). Forest stands treated with prescribed fire exhibited greater nitrogen and plant diversity than control plots where fire had been excluded. No significant difference was found in plots where mechanical treatments were applied.

Determination of Significance

Impact 2a substantially increase unstable areas or other geologic hazards (thresholds B and C)
Less than significant impact with mitigation

Removal of vegetation through fuel reduction and other VTP projects can increase soil moisture retention by reducing evapo-transpiration rates and reducing interception losses. As soil moisture levels and pore water pressures increase, frictional forces between bedding planes and soil particles decrease, which increases the potential for landslides (California Division of Mines and Geology, 1997). The cumulative impact of multiple vegetation treatment projects within a single watershed in a short period of time may increase the potential for landslides, depending on the location of projects and the ability of project planning to avoid activities on landslide-prone hillslopes. The Proposed Program includes Minimum Management Requirements (MMRs) that restrict operation of heavy equipment of known or potentially active unstable areas or saturated soils.

Project alternatives with prescribed fire and mechanical treatments both have the potential to increase risks of erosion and landslides through the removal of vegetation and a reduction in root strength. Alternatives that utilize grazing as a treatment method may have the least impact.

Impact 2b substantially increase soil erosion rates or degrade soil productivity (thresholds A)
No impact with mitigation

Land disturbance and exposed soil from multiple vegetation treatments or other projects within a watershed has the potential to accelerate soil erosion rates. As described in the background Section, burning from fires has the potential to mobilize and volatize nutrients which through cumulative treatments has the potential to affect soil productivity. The magnitude of these effects are largely site dependent and are best evaluated at the project scale (Page-Dumroese et al., 2010).

Project alternatives that rely on prescribed fire as a primary treatment have the greatest potential to remove vegetation cover and expose soil. The use of mechanical treatments in Alternatives 1-4 may have effects on soil erosion through soil compaction and removal of surface cover.

Mitigation Measure(s):

- No additional mitigation measures beyond those listed in Section 5.15.1 through 5.15.13

6.4.3 Cumulative Effects – Wildfire Severity and Extent

This section evaluates potential cumulative effects of implementing the Proposed Program and Alternatives on wildfire severity and wildfire extent. Section 5.2 provides an evaluation of direct effects of the program and alternatives on wildfire severity.

Significance Criteria

The impact criteria and determination threshold used to evaluate potential cumulative effects on wildfire severity is the same as the criteria developed in Section 5.2.

The Program and Alternatives would create a significant effect if treatments:

a) Expose people or structures to the risk of loss, injury or death involving wildfires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.

Determination Threshold

The Program and Alternatives will have a significant adverse effect if treatments ultimately result in an:

a) Increase of 50% or more in the short term size and intensity of individual fires; or
b) Increase of 50% or more in the frequency of large-scale fires

Fifty percent was chosen as the threshold because year-to-year differences are such that changes less than 50% are likely to be masked by the large variation of wildfire size and large-scale wildfire frequency both today and in the future. For instance, the yearly average acreage burned by wildfire in California since 1950 is 230,000 acres plus or minus 195,250 acres, which is a coefficient of variation of 85%.

Determination of Significance

-Beneficial effect; no mitigation needed

The effect of the program and alternatives on wildfire severity is evaluated in Section 5.2. The finding suggests that the program and alternatives all are unlikely to increase the frequency of wildfires and have the potential to decrease the number of high severity wildfires that occur. Federal agencies are also implementing projects aimed at reducing high severity wildfires. On federal lands approximately 250,000 acres of fuel treatments are implemented annually. When combined with the annual (over ten years) average of 217,000 acres treated in the Proposed Program, roughly 467,000 acres of vegetation could be expected to receive treatment annually. The combined cumulative effect of both federal and state programs should result in a beneficial effect by reducing the frequency of high severity wildfires. However, the degree to which fire severity is decreased is not known[1]. What is known is that over the last seven years fuel treatment projects have been concentrated in the Sierra and North Coast bioregions. A substantial number of acres have been treated in the Sacramento Valley, Modoc, and San Joaquin Valley bioregions as well. When combined with efforts from the proposed state program, these bioregions are most likely to see the greatest reductions in frequency of high severity fires. The Central Coast, South Coast, and desert bioregions have received far fewer treatments. Given the size of the proposed VTP program combined with similar fuel reduction projects on federal lands, it is unlikely that the Proposed Program will result in an increase (50% or more) in short-term size and intensity of individual fires or an increase (50% or more) in the frequency of large-scale fires.

Fuel reduction projects on private and public lands are being conducted not with the intent of eliminating wildfires, but with the intent of reducing the risk of high severity wildfires, particularly near areas with high asset values. These efforts to change wildfire behavior are relatively new and there are limited studies on the effects of fuel reduction projects. There are many examples of situations where fuel treatment projects have effectively reduced the intensity of a wildfire as it passed through a treated forest stand (Finney et al., 2005; Agee et al., 2000; Pollet and Omi, 2002; Murphy et al., 2007; Safford et al., 2009). Mechanical treatments have the ability to more precisely alter stand structure than does prescribed fire (Graham et al., 2004).

Research has suggested that about 35% of a watershed needs to be treated over a 10 year time period to effectively change wildfire behavior (Finney, 2001). The proposed VTP program and similar federal programs for fuel reduction are still unlikely to achieve this target for most watersheds. With limited funds, fuel treatment projects are typically targeted for areas with high asset values.

The proposed VTP program when combined with federal efforts for fuel reduction is likely to have a cumulative effect that is beneficial for watersheds where treatments are conducted and maintained. The beneficial effect is greatest for the Proposed Program and Alternatives 2 and 3, that are expected to treat about 217,000 acres annually in any given ten year period. Alternatives 1 (status quo) and Alternative 4 treat a fewer number of acres and the ability to reduce wildland fire is less.

Mitigation(s)

- No mitigations necessary.

6.4.4 Cumulative Effects – Air Quality

This section evaluates potential cumulative effects to air quality that may result from implementing the Proposed Program or any of the alternatives. (Table 6.4.3)

[1] Historically, it is estimated that the annual acreage burned prior to the arrival of European settlers (pre-1800) was 4.5 million acres (Stephens et al., 2007).

Cumulative Effects Analysis

Significance Criteria

The following is a subset of the criteria presented in Section 5.6 (*Air Quality*) and used here to evaluate potential cumulative effects to air quality. Based on CEQA, Appendix G, cumulative effects to air quality are considered significant if the program or alternatives:

a) *Conflict with or obstruct implementation of the applicable air quality plan;*
b) *Violate any air quality standard or contribute to an existing or projected air quality violation;*
c) *Result in a cumulatively considerable net increase of any criteria pollutant for which the region is in non-attainment under an applicable federal or state ambient air quality standard, (including releasing emissions that exceed quantitative thresholds for ozone precursors);*
d) *Expose sensitive receptors to substantial pollutant concentrations.*

Determination Threshold

U.S. EPA and California Air Resources Board (CARB) each establish ambient air quality standards (NAAQS and CAAQS) for the following pollutants: ozone (O2), Carbon Monoxide (CO), Particulate Matter (PM10), Nitrogen Dioxide (NO2), and Sulfur Dioxide (SO2). Air quality standards are presented in Chapter 5, Table 5.6.1. Appendix A and Chapter 4 are also applicable in evaluating cumulative effects to air quality.

Impact Evaluation

Prescribed burning is an essential tool for restoring and maintaining the health of fire dependent ecosystems. However, as discussed in Section 5.6 (Table 5.6.4), prescribed burning is also the primary treatment method that has the greatest potential to impact air quality. Other treatment methods (mechanical, hand, herbicides, and herbivory) are considered to have minor effects to air quality that are considered less than significant.

Emissions (see Section 5.6, *Air Quality*) for the Proposed Program was estimated by determining the total fuel load (tons/acre) for each vegetation type, determining the fuel consumption value, and then applying the emissions factor that corresponds to the appropriate fuel type.

Emissions data is also presented in the environmental setting (Section 4.6). To examine potential cumulative effects from prescribed burning, emissions were estimated for prescribed burns that took place in 2005 on both private and federal lands (Table 6.4.3). Projects on private and state lands are vegetation management projects that CAL FIRE undertook. In 2005, a total of 266 prescribed burns were recorded. Of these, 44 projects were CAL FIRE funded projects, and 212 were federal projects (USFS, BLM, NPS, and Military). With fewer projects a much smaller portion of the total emissions were associated with CAL FIRE prescribed fire projects. For example, prescribed burning under CAL FIRE represented 24% of total emissions for PM10 and 46% for PM2.5. There were however regional differences. The greatest concentration of CAL FIRE projects, and sources of emissions, was located in the North Central Coast, South Central Coast, and Sacramento Valley Air Basins. Conversely, there were no federal prescribed burns in the Central Coast Air Basins. The greatest emission sources from federal prescribed fires were located within the Sacramento Valley, Northeast Plateau, and Mountain Counties Air Basins.

Table 6.4.3 Emissions Estimates for Prescribed Burn Projects that were Recorded in 2005 (Units are in Total Tons)								
BASIN	**Emission Type**							
PRIVATE or STATE	**PM10**	**PM2.5**	**CO2**	**CO**	**SO2**	**NOX**	**NMHC**	**CH4**
Great Basin Valleys	-	-	-	-	-	-	-	-
Lake County	3	2	404	20	0	2	2	1
Lake Tahoe	0	0	22	2	0	0	0	0
Mountain Counties	5	5	781	50	0	2	3	2
North Central Coast	209	178	33,235	1,667	9	125	195	68
North Coast	2	2	310	17	0	1	1	1
Northeast Plateau	-	-	-	-	-	-	-	-
Sacramento Valley	111	94	17,774	890	5	65	101	38
San Diego County	12	11	2,068	95	1	8	12	4
San Francisco Bay	9	8	1,494	73	0	5	8	3
San Joaquin Valley	-	-	-	-	-	-	-	-
South Central Coast	64	55	10,481	499	3	41	62	20
South Coast	6	5	1,222	48	0	4	5	3
Sub-Total	421	359	67,791	3,360	18	253	389	141
Percent of Total	24%	46%	26%	8%	26%	37%	36%	20%
BASIN	**Emission Type**							
FEDERAL	**PM_10**	**PM_2.5**	**CO2**	**CO**	**SO2**	**Nox**	**NMHC**	**CH4**
Great Basin Valleys	78	52	12,172	1,204	3	42	65	27
Lake County	28	17	4,028	474	1	11	18	12
Lake Tahoe	-	-	-	-	-	-	-	-
Mountain Counties	319	51	43,991	11,696	12	77	123	150
North Central Coast	-	-	-	-	-	-	-	-
North Coast	15	8	2,259	313	1	7	10	6
Northeast Plateau	315	89	45,264	10,003	12	103	162	137
Sacramento Valley	366	148	53,862	9,696	15	142	222	150
San Diego County	-	-	-	-	-	-	-	-
San Francisco Bay	5	4	782	36	0	3	4	2
San Joaquin Valley	180	55	25,698	5,556	7	55	88	81
South Central Coast	-	-	-	-	-	-	-	-
South Coast	0	0	39	2	0	0	0	0
Sub-Total	1,307	424	188,094	38,980	51	439	692	565
Percent of Total	76%	54%	74%	92%	74%	63%	64%	80%
Total	**1,728**	**783**	**255,885**	**42,340**	**69**	**692**	**1,081**	**706**

<u>Contribution of the VTP program to Air Quality Emissions</u>

Table 6.4.4 compares estimated emissions from the proposed VTP program with other sources. Baseline conditions are represented for 2005 and future conditions with the impact of the VTP program are estimated for 2010. For all pollutants the cumulative addition of emissions from the VTP program was less than 1% of total emissions. Overall emissions from Carbon Monoxide (CO) are shown to decrease between 2005 and 2010 due to reductions in emissions from mobile sources. The additional cumulative impact of the VTP is 0.6% of total CO emissions. Particulate matter, PM10 and

PM2.5, are both expected to show moderate increases between 2005 and 2010. The additional cumulative impact of the VTP program is 0.3% for PM10 and 0.7% for PM2.5. There is no overall increase expected for nitrogen dioxide (NO2) and a slight increase expected for sulfur dioxide (SO2). The expected contribution of the VTP program beyond the status quo is 0.1% of total emissions for both NO2 and SO2.

Table 6.4.4
Air Quality from All Sources

	CO	Mobile Sources	Area Sources: Rx Burning (Existing)	Area Sources: VTP Proposed	Area Sources: Ag Burning	Stationary Sources	Other Sources	Total From All Sources
Carbon Dioxide	CO 2005 (ton/yr)	4,080,222	639,089		60,656	106,405	138,080	5,024,451
	% of Total	81.2%	12.7%		1.2%	2.1%	2.7%	100%
	CO 2010 (ton/yr)	3,198,123	649,474	23,883	59,907	112,690	143,507	4,187,584
	% of Total	76.4%	15.5%	0.6%	1.4%	2.7%	3.4%	100%
Particulate Matter 10	PM10 2005 (ton/yr)	40,767	63,006		562,042	117,928	23,670	807,413
	% of Total	5.0%	7.8%		69.6%	14.6%	2.9%	100%
	PM10 2010 (ton/yr)	41,595	63,919	2,690	566,706	126,838	23,634	825,382
	%of Total	5.0%	7.7%	0.3%	68.7%	15.4%	2.9%	100%
Particulate Matter 2.5	PM2.5 2005 (ton/yr)	33,087	56,214		178,032	27,156	20,834	315,324
	% of Total	10.5%	17.8%		56.5%	8.6%	6.6%	100%
	PM2.5 2010 (ton/yr)	33,474	57,079	2,367	180,336	29,335	20,725	323,315
	% of Total	10.4%	17.7%	0.7%	55.8%	9.1%	6.4%	100%
Nitrogen Dioxide	NO2 2005 (ton/yr)	952,077	10,859		19,090	148,529	44,519	1,175,074
	% of Total	81.0%	0.9%		1.6%	12.7%	3.8%	100%
	NO2 2010 (ton/yr)	775,249	1	1343	16,312	153,150	44,501	1,001,750
	% of Total	77.4%	1.1%	0.1%	1.6%	15.3%	4.4%	100%
Sulfur Dioxide	SO2 2005 (ton/yr)	86,567	2,493		4,015	14,768	2,365	110,208
	% of Total	78.6%	2.3%		3.6%	13.3%	2.1%	100%
	SO2 2010 (ton/yr)	96,955	2,493	117	4,037	17,129	2,026	122,640
	% of Total	79.1%	2.0%	0.1%	3.3%	14.0%	1.7%	100%

Source: CARB, 2005

Comparison of Alternatives

As shown in Table 3.10, the Proposed Program treats on average 217,000 acres per year over a ten year period, and is likely to result in higher emissions through the increased use of prescribed fire (53% of total acres), but also has the greatest potential to reduce high severity fires through a greater reduction in fuel loads (see Section 5.6 for estimated reduction in emissions from wildfires). Alternative 1 (status quo) uses prescribed fire as a treatment at a higher rate than the Proposed Program (63%), but treats a smaller number of acres (47,000 per year average over a decade). Alternative 4, treats fewer acres (93,000 average per year over 10 years) and reduces the use of prescribed fire (8% of total acres treated), and is likely to have the lowest contribution to air pollution. However, by treating fewer acres it is less likely to reduce the frequency of high severity wild fires. Alternatives 2 and 3 operate under the same cap as the Proposed Program and would be expected to have the similar impact on air pollution. See Table 5.6.6 for a comparison of pollutants emitted by alternative.

Determination of Significance

With many of California's air basins in non-attainment for PM10 and Ozone, the program is likely to be operating in an impaired environment and has the potential to add to the cumulative effects already present. Given the distribution of federal lands, cumulative effects to air quality are most likely to occur in the Mountain Counties, Sacramento Valley and San Joaquin Valley.

The use of prescribed fire is necessary both to protect communities (people and structures) and to maintain the health of fire dependent ecosystems. Prescribed burns both on private and federal lands are intended to reduce hazardous fuel loads and reduce the risk of high severity fires. Chapter 5, Tables 5.6.7 and 5.6.8 summarize potential reductions in emissions from wildfires as a result of the Proposed Program. The analysis suggests that treatments from the Proposed Program could reduce wildfire severity from severe to low/moderate on 29,000 acres (average burned annually). The analysis suggests that the estimated reduction in severe wildfires could decrease CO emissions by 36,000 tons, PM10 by 3,100 tons and PM2.5 by 2,500 tons. These are considered rough estimates with a low level of certainty. Due to the complexity of wildfire behavior and limited information on federal lands, the cumulative effect of a potential reduction in air pollutants, as a result of decreases in high severity wildfires from implementing fuel treatments across all lands was not evaluated quantitatively. As stated in Chapter 5, there is a likely reduction in high severity wildfires from implementing fuel reduction projects, but presently this cannot be predicted with a high degree of certainty.

Until a substantial number of fuel reduction projects are implemented that effectively reduce the frequency of high severity fires, it is possible that without effective mitigations air pollution may increase. This may result in an increase in emissions from a short term increase in prescribed burning coupled with the same or higher level of wildland fires. In the long run, it is anticipated that there will be a cumulative effect that is beneficial (i.e., reduction in air pollutants) with a noticeable decrease in the frequency of wildland fires.

Impact A: Air Quality Cumulative Effects (violate any air quality standard)
- Less than significant impact with mitigations

Section 5.6 (*Air Quality*) found that emissions from five of six criteria pollutants in the Proposed Program may exceed thresholds for CO, PM10 and ozone precursors (NMHCs) in all air basins except for the Lake Tahoe Air Basin. The findings state that this is a potentially significant effect because total emission of criteria pollutants will likely exceed California's Ambient Air Quality Standards. However, when compared to other sources, the additional emissions from the proposed VTP program are relatively small and represent less than 1% of total emissions for all criteria pollutants (see Table 6.4.4).

Prescribed fire in combination with other management techniques is needed to restore wildland forests and to reduce the buildup of fuels and the risk of high severity wild fires. Given the current concerns about increased risks of wildland fires it is likely that the use of prescribed fire will increase over the next decade on both private and federal lands. Unfortunately, prescribed fire has the potential to degrade ambient air quality, impact visual quality and temporarily expose the public to unhealthy pollutants. Regulatory agencies and the public must balance the trade-off between the shorter term effects associated with prescribed fire and the longer terms effects associated with increases in number and frequency of high severity wildland fires. With the increased use of prescribed burning, the potential exists for cumulative impacts to air quality which will require appropriate mitigations.

The potential also exists for longer term beneficial effects. To the degree that fuel treatment projects on private and federal lands can reduce the size and frequency of wildfires there should be reductions in air pollution from wildfires. Studies have shown that emissions from wildfires are 30% - 40% greater than that of prescribed burns (Ahuja, 2006). In addition, the potential particulate matter (PM10) from a wildfire is twice the amount as from a prescribed fire of the same size. As more and more areas are treated and maintained over time there should be a reduction in the frequency of large high severity fires and a corresponding reduction in air pollution from wildfires.

In the short-term the increased use of prescribed fire through the state VTP and federal projects may contribute to adverse cumulative impacts on air quality in Air Basins that are currently impaired. However, the expected emissions from the VTP program are relatively small compared to all other existing sources (see Table 6.4.4). In addition, there are many existing programs in place to minimize impacts to air quality from prescribed burning. California's Smoke Management Program addresses potentially harmful smoke impacts from prescribed burning on forest and range land. The Smoke Management Guidelines for Agricultural and Prescribed Burning (CARB, Title 17) allows for the controlled use of prescribed burning while establishing specific protocols that minimize environmental impacts (California Air Resources Board (CARB)). Under these guidelines the ARB determines permissive burn days. This measure reduces the likelihood of burning occurring in impaired conditions, where the proposed project is likely to further degrade air quality, and add to an adverse cumulative impact. In addition, a Burn Plan is required for all prescribed burn projects greater than 10 acres. Through the development of Burn Plans, and compliance with all other elements of title 17, VTP burn projects will be designed to minimize air quality impacts. Title 17 has a number of requirements designed to reduce smoke impacts that include: submittal of a Smoke Management Plan, checking meteorological conditions, evaluation of alternatives, public notification, monitoring, and coordination with the Air Resources Board or local Air District. The specific requirements in Title 17 for prescribed burning can be found on the CARB web site: www.arb.ca.gov/smp/smp.htm.

With these existing regulations and mitigation measures in place, the impact of the VTP program on air quality will be reduced to a level that is less than significant.

Impact B Air Quality Cumulative Effects – Visibility

- Less than significant; no mitigation necessary
(see Sections 4.6.6 and 5.6 for additional information)

Smoke from wildfires and prescribed fires can have a cumulative impact that leads to poor local visibility and regional haze. The regional haze rule, developed by the U.S. EPA, is a set of regulations that require states to review how pollution emissions across a broad region within the state affect visibility in Class I areas (EPA, 1999). Class I areas include national parks and wilderness areas. These rules also require states to make reasonable progress in reducing effects of this pollution on visibility conditions in Class I areas and to prevent future impairment of visibility. The state is required by the rule to find a way to improve air quality in class I areas from current condition to natural condition within 60 years. Natural condition is a term used in the Clean Air Act (CAA) that refers to the condition where no human-caused pollution impairs visibility.

Visibility is an important public welfare consideration because of its significance to enjoyment of daily activities in all parts of the country. Protection of visibility as a public welfare consideration is addressed nationally through the secondary PM NAAQS, which are equivalent to the primary PM NAAQS. Visibility protection is particularly important in the 29 mandatory Class I Federal areas, "Areas of Great Scenic Importance," and is addressed for these areas by the special provisions of Sections 169A and 169 B of the CAA.

The Western Regional Air Partnership (WRAP) is developing guidelines for enhanced smoke management through the Fire Emission Joint Forum. States will utilize these guidelines to develop a state implementation plan (SIP) for visibility, as is required under the regional haze rule. WRAP considers that prescribed burns conducted for ecosystem maintenance and wildfires that are allowed to burn to restore native vegetation are part of the natural condition that is expected to occur across the landscape (Ahuja, 2006).

CAL FIRE prescribed burns require a Smoke Management Plan (SMP). This is typically done with consultation from local Air Districts. The plans should help mitigate and avoid excessive contributions to regional haze and long term effects to visibility. SMPs establish a basic framework of procedures and requirements for managing smoke from fires managed for resource benefits. The purposes of SMPs are to mitigate the nuisance and public safety hazards posed by smoke intrusions into populated areas; to prevent deterioration of air quality and NAAQS violations; and to address visibility effects in mandatory Class I Federal areas. Smoke Management Plans are designed to minimize emission of air pollutants and operate under conditions that are favorable for smoke dispersion.

Prescribed fire combined with naturally occurring wildfires has the potential to cumulatively contribute to reductions in visibility. However, since fire is a naturally occurring feature on the landscape it is difficult to separate the two, particularly in cases where prescribed fire is used as a tool for ecosystem maintenance. In addition, the visible impairments from prescribed burns are in most cases a short term impact (1-2 days). The small size of the projects compared to the much larger contribution of wildfires makes the contribution less than significant. Any mitigations that are needed will be incorporated into Smoke Management Plans.

Mitigation(s)

The following Minimum Management Requirements address potential cumulative effects from air quality and should lessen the potential for cumulative effects to air quality:

MMR 3 - All state and local air quality regulations and ordinances will be complied with and the local Air Pollution Control District (APCD) or Air Quality Management District (AQMD) will be contacted to determine local requirements (and/or potential exemptions for fuels reduction projects).

MMR 4 - Burning will only occur on Burn Days as determined by the Air Resources Board except 1) in areas declared to be fire hazards, or 2) if a permit to burn on No-Burn Days has been obtained from an Air Pollution Control District based on a determination that denial to burn would threaten imminent and substantial economic loss.

In addition, the California Air Resources Board (CARB) has developed a Prescribed Fire Incident Reporting System (PFIRS). PFIRS is a web-based system that allows land managers to enter information that is part of a Smoke Management Plan. VTP projects that use prescribed burning as a treatment will be required to submit project level information to the PFIRS database. This will allow CARB, CAL FIRE, and other responsible entities to evaluate emissions and potential cumulative effects from multiple burn projects.

6.4.5 Cumulative Effects – Archeological and Cultural Resources

This section evaluates potential cumulative effects to archeological and cultural resources that may result from implementing the Proposed Program or any of the alternatives.

Significance Criteria

The significance criteria and thresholds used for evaluating archeological and cultural resources in Section 5.8 are appropriate for addressing cumulative effects as well.

Appendix G of the CEQA Guidelines, the CEQA Environmental Checklist, specifies that the Program and Alternatives would have a significant adverse effect to prehistoric, historic, and paleontological resources if any of them would:

a) Cause an adverse change in the significance of a historical resource, as defined in Section 15064.5 of the California Environmental Quality Act Deskbook (Bass et al., 1999);
b) Cause an adverse change in the significance of an archaeological resource, pursuant to Section 15064.5 of the CEQA Deskbook;
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature;
d) Disturb any human remains; including those interred outside of formal cemeteries.
e) Cause an adverse change to locations associated with the traditional beliefs of Native Americans, including areas used or assumed to be used for ceremonial activities, or
f) Cause an adverse change to locations and or resources used by Native Americans to carry out or support economic, artistic, or other cultural practices.

Cumulative Effects Analysis

Determination Threshold

The thresholds used are the same as those presented in Section 5.8.2.

Archaeological Resource

Any change in the classification or potential classification of an archaeological resource that reduces it from significant or potentially significant (in the historical sense, as described above) to less than significant is considered a significant adverse impact (in environmental assessment terminology) from the program.

Historical Resource

A “substantial adverse change” in the significance of an historical resource means physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historical resource would be materially impaired.

The significance of an historical resource is materially impaired when a project demolishes or materially alters in an adverse manner the physical characteristics of a historical resource so that it would no longer be included in the California Register of Historic Places or a local register of historical resources (Bass et al., 1999). The criteria for listing are included in Section 4.8.2 of this document.

Ethnographic Resource

An adverse change to an ethnographic resource is one that would lessen the ability of Native Americans to access traditional sites, as defined above, or to utilize such sites or the resources therein for their traditional purposes.

Determination of Significance

- No significant impact (see Section 5.8 for details)

Section 5.8, addresses potential effects to cultural resources that include: prehistoric, historic, ethnographic, and paleontological. Given the abundance of cultural resources across the state, the increase in vegetation treatments that would result from the Proposed Program and alternatives has the potential to contribute to a cumulative effect. The potential impact from different treatment methods and appropriate management methods to prevent significant adverse effects are addressed in Section 5.8. The review procedures as described in Archaeological Review Procedures for CAL FIRE Projects (January, 2003, updated November, 2006), and included under Minimum Management Requirement 7, include an evaluation of the potential for cumulative effects. With the increased number of prescribed burns and other vegetation management projects on private and federal lands, the potential exists that archaeological, historical and ethnographic resources could be disturbed with a greater frequency and hence the impact could be cumulative. The CAL FIRE project protocol, which includes review by professional archaeologists as needed, and the Minimum Management Requirement (MMR 7) should reduce the impact to less than significant. See Section 5.8 for additional information on the CAL FIRE protocol for archaeological review.

Mitigation(s)

No mitigation measures required.

6.4.6 Cumulative Effects – Visual / Aesthetic Resources

This section summarizes the effects to visual and aesthetic resources due to implementing either the Proposed Program or any of the alternatives. Program effects to visual and aesthetic resources are analyzed in Section 5.13. The following significance criteria and thresholds were identified and are used here to evaluate potential cumulative effects.

Significance Criteria

The significance criteria and thresholds used for evaluating archeological and cultural resources in Section 5.8 are appropriate for addressing cumulative effects as well. According to Appendix G of the CEQA Guidelines: the CEQA Environmental Checklist, an aesthetic impact would be considered significant if the Program and Alternatives would:

a) Have an adverse effect on a scenic vista,
b) Damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway,
c) Degrade the existing visual character or quality of the site and its surroundings.

Determination Threshold

Visual effects from the program would be considered significant if the acreage of treatments causing adverse and long term effects, as determined through the analysis process, exceeds more than 10% of the scenic byways viewshed acreage within that bioregion in any 10 year period.

Determination of Significance

- Less than significant; no mitigations needed

Visual effects from vegetation treatments tend to have very localized and project specific effects. Treatments effects that may impair visual or aesthetic conditions in one location don't combine to degrade conditions at another location. When treatments occur in the same area they may cumulatively add to the total amount of viewshed acreage that is temporarily impaired. The perceived impact to visual quality varies substantially with the treatment method. Scorched ground and tree trunks from a prescribed fire are likely to be viewed negatively, especially if the fire kills overstory trees. However, this is not a permanent impact. Studies have shown that the perception of visual quality of a forested area can improve within one to two years following a low intensity prescribed fire (Jakes, 2006a). Mechanical treatments also can affect visual quality.

The public tends to perceive clearcuts negatively (Bliss, 2000), while thinning that reduces stand density has been shown to improve visual quality (Jakes, 2006b). Treatment of slash is another factor that affects visual quality. Studies have shown that increasing amounts of slash and downed woody material decrease the perception of visual quality.

The threshold of 10% or more of the viewshed acreage in a bioregion in a 10 year time period is a measure of the potential cumulative effects of the program. The findings resulted in a determination of a negligible or less than significant impact. At a programmatic level there is unlikely to be a noticeable impact at the bioregion or state level. Any project level effects are likely to be short-term effects to visual resources that results from vegetation treatments. In addition, many projects occur on private lands where public access is limited and the opportunity for visual impairments is less likely.

Cumulative Effects Analysis

Prescribed burn projects generate smoke which has the potential to contribute to short term effects to visibility and longer term effects to regional haze. These issues are addressed in Sections 4.6, 5.6, and under cumulative effects to air quality. Consistent with the findings in Section 5.6, the cumulative effects to visual resources are considered less than significant.

Mitigation(s)

- No mitigations needed.

6.4.7 Cumulative Effects – Noise

This section evaluates potential cumulative effects to noise due to implementing either the Proposed Program or any of the alternatives. Program effects to noise are analyzed in Section 5.12. Evaluation of cumulative effects to noise is based on the same criteria and thresholds presented in Sections 5.12.1 and 5.12.2.

Significance Criteria

The significance criteria and thresholds used for evaluating noise in Section 5.12 are appropriate for addressing cumulative effects as well.

Noise effects would be considered significant if the Program and the Alternatives would cause:

A. Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
B. Exposure of persons to, or generation of, excessive ground-borne vibration or ground-borne noise levels;
C. Substantial permanent increase in ambient noise levels in the project vicinity (above levels existing without the project); or
D. Substantial temporary increase in ambient noise levels in the project vicinity (above levels existing without the project).

Determination Threshold

The Program and Alternatives are evaluated using thresholds established in Section 5.12 and are considered to create a significant effect when a treatment or treatments creates:

A. Noise in excess of 90 dBA at 50 feet, or in excess of 65 dBA at 1,600 feet at sensitive receptors (e.g. schools, residential units, churches, libraries, commercial lodging facilities, and hospitals, or care facilities).
B. Noise levels in excess of 70 dBA L_{dn}.
C. The Program and Alternatives are considered to create moderately adverse effects when noise levels are between 60 and 70 dBA L_{dn} (State Office of Noise Control 1976).

Potential effects related to noise from proposed project activities, or any of the alternatives, are described in Section 5.12 (*Noise*). That section discusses the potential for noise effects from management activities that include: mowing, operating heavy machinery (dozers, excavators, etc.), chain saws, trucks, helicopters, and hand equipment. Noise effects occur only if the noise is heard or felt by a receptor. Sensitive human receptor concerns given particular consideration in Section 5.12.4

are recreation areas and residential areas. Wildlife also can be a sensitive noise receptor, particularly during the reproduction season (see Table 4.12.2).

Disturbances associated with mechanical treatments could be substantial, though short in duration. Equipment associated with mechanical treatments can generate noise levels ranging from approximately 75 to 90 dBA at 50 feet, depending upon the equipment being used. Typical operating cycles may involve two minutes of full-power operation, followed by three or four minutes of operation at lower levels. With most projects occurring in rural areas, it is unlikely that project noise will combine with other sources of noise to create a chronic or persistent impact. VTP projects particularly within WUI could have a cumulative impact to noise. However, the effects are short lived and implementing management measures should reduce the impact to less than significant.

For a cumulative noise related effect, VTP projects would need to add to existing ambient noise levels to cause a significant adverse impact, or that noise from two or more individual projects combines to create such an impact. Standards for what constitutes a significant cumulative noise impact in rural forest and range settings, where most projects occur, are not well defined. For effects to occur, cumulative noise must be heard or felt.

Determination of Significance

Implementation of the VTP Proposed Program or any of the alternatives will not result in a measurable bioregional cumulative effect contribution to noise after mitigation measures are applied at the project scale. The majority of projects will occur in remote areas and VTP projects occurring concurrently with other noise producing land management activities are expected to be few in number and are generally undeterminable at the scale of the bioregion.

Substantial permanent or temporary increase in ambient noise levels or exposure of persons to noise or vibration levels above applicable local general plan, noise ordinance or other agency standards are not expected with the application of project specific mitigation measures and are similarly not cumulatively measurable when assessed at the scale of the bioregion. When examined at the scale of a bioregion, VTP projects typically occur in a wildland or wildland/urban interface setting. The vast majority of the noise generated from the Proposed Program and Alternatives is located significant distances away from sensitive receptors. Noise effects arising from the Proposed Program or any of the alternatives are of short duration (<10 weeks per project on average) and limited to typical workday hours that may also be seasonally limited. Additionally, VTP projects are expected to be relatively few in number and occurrence. For the Proposed Program, on an annual basis, 88% of watersheds within the program area will not receive any VTP treatments. For the 12% of watersheds that do support a VTP project, 98% of them will receive 3 treatments or less and most (83%) will only receive 1 treatment annually (Table 5.0.6).

Some projects will likely occur in the WUI (Wildland/Urban Interface) where operations could occur adjacent to residences and other sensitive receptors. Noise in these situations is generally recognized as a necessary element toward achievement of other desirable land condition objectives. Few VTP projects are expected to occur immediately subsequent to other noise generating land management activities and thus the cumulative duration of noise generation is negligible. It is highly unlikely that a single residential or commercial area will be affected by the noise from more than one watershed treated annually and concurrent with or subsequent to other noise generating land management activities.

The cumulative contribution to duration of unwanted noise levels to sensitive receptors is negligible at the scale of the bioregion. Adoption of Proposed Program mitigation measures reduces individual project level effects to a negligible level that are unlikely to create a cumulative impact to baseline noise levels. Mitigation measures are presented in Section 5.12.9. No contribution to cumulative duration of noise effects is expected.

Mitigation(s)

- No additional mitigation is needed beyond those listed 5.12.9.

6.4.8 Cumulative Effects – Transportation

This section evaluates potential cumulative effects to transportation due to implementing either the Proposed Program or any of the alternatives. Program effects to transportation are analyzed in Section 5.10. Evaluation of cumulative effects to transportation is based on the same criteria and thresholds presented in Sections 5.10.1 and 5.10.2.

Significance Criteria

A cumulative effect will be considered significant if results of the analysis indicate that any of the following criteria will be met due to implementation of the Program or Alternatives:

1. An increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections).
2. Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways.

Determination Threshold

The following threshold is used to determine whether there is a substantial adverse effect to local residential or commercial development due to traffic generated by the Program or any of the Alternatives:

- Traffic increases in excess of 10% Average Daily Trips (ADT) of the capacity of roads that serve residential and/or commercial areas near project areas.

Potential effects related to transportation from proposed project activities, or any of the alternatives, are described in Section 5.10 (*Transportation/Traffic*). That section discusses the potential for transportation effects associated with increases in traffic volume associated with trips to and from the project site. The findings suggest that most projects are likely to have 5-10 vehicles traveling to and from the work site each day, which result in 10-20 average daily trips (ADT) per project.

Implementation of the VTP Proposed Program or any of the alternatives will not result in a measurable cumulative effect contribution to traffic volume. No substantial increase in vehicle trips, volume to capacity ratio or increase in intersection congestion is detectable at the scale of the bioregion. Similarly, no cumulative effect contribution to level of service standards established by county congestion management agency for roads or highways is detectable at the scale of the bioregion. The majority of projects will occur in remote areas and background traffic and transportation levels on these road systems are generally well below road capacity.

Individual VTP projects conducted under any alternative may have local and short-term effects on transportation/traffic impact measures. These effects may be detectable at the scale of the project and are mitigated to negligible or less than significant levels as a part of project planning and implementation at that scale of analysis. For the Proposed Program, on an annual basis, 88% of watersheds within the program area will not receive any VTP treatments. For the 12% of watersheds that do support a VTP project, 98% of them will receive 3 treatments or less and most (83%) will only receive 1 treatment annually. Additionally, the number of ADT generated per project is expected to be well below the capacity of typical low volume roads. It is highly unlikely that vehicle traffic associated with VTP project implementation will occur concurrently with other land management activities in a remote wildland setting and utilizing the same or redundant portions of an established road system.

Determination of Significance

No significant cumulative effects are expected from implementing the Program or any of the Alternatives.

Mitigation(s)

- No mitigation necessary beyond those listed in Section 5.10.8.

6.4.9 Cumulative Effects – Population and Housing

This section summarizes the potential for cumulative effects to Population and Housing due to implementing either the Proposed Program or any of the alternatives. Program effects to Population and Housing are analyzed in Section 5.9. The following significance criteria and threshold were identified and are used here to evaluate potential cumulative effects.

Significance Criteria

Appendix G of the CEQA Guidelines, the CEQA Environmental Checklist, contains only one question, which is relevant to the VTP program. The Program and Alternatives would be considered to create a significant effect if treatments:

> Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure).

Determination Threshold

As stated in Section 5.9.3, there is not an accepted threshold for evaluating a significant change in population. Population increases less than 0.5% were considered negligible.

Cumulative Effects Analysis

Determination of Significance

There is no growth inducing effects associated with VTP projects. The only changes to population, as discussed in Section 5.9.3, are temporary increases associated with workers traveling into an area to complete a vegetation management project.

No significant cumulative effects are expected from implementing the Program or any of the Alternatives.

Mitigation(s)

- No mitigation necessary.

6.4.10 Cumulative Effects – Recreation

This section summarizes the potential for cumulative effects to Recreation due to implementing either the Proposed Program or any of the Alternatives. Program effects to Recreation are analyzed in Section 5.14. The same significance criteria and thresholds that were identified in Section 5.14.1 and Section 5.14.3 are used here to evaluate potential cumulative effects.

Significance Criteria

Appendix G of the CEQA Guidelines, the CEQA Environmental Checklist, poses the following questions to be considered in determining whether the Program or Alternatives would cause significant effects to recreation:

The Program and Alternatives would create significant effects if they would:

a) Reduce quality of recreational experience resulting from presence of highly visible blackened areas;
b) Reduce quality of recreational experience resulting from presence of highly visible areas cleared of vegetation by mechanical or manual treatments;
c) Reduce quality of recreational experience resulting from presence of highly visible areas of dead and browned vegetation resulting from herbicide control of non-native exotic plants and/or noxious weeds;
d) Reduce recreational enjoyment due to the presence of increased smoke;
e) Require temporary exclusion of visitors from or closure of recreational facilities during treatments.

Determination Threshold

An effect is considered significant if it would:

1) Close more than 1% of state park lands, or other public recreational area because of VTP treatments during the peak visitor season over a calendar year.

2) Severely reduce visual quality (more than 80% burned and black, cleared of vegetation, or comprised of dead plants) on more than 10% of the area of any one state park, or other public recreational area, during the peak visitor season over a calendar year.

Cumulative Effects Analysis

The estimation of effects (Section 5.14) is based on the temporal and spatial extent of VTP treatments that are likely to occur on state parks or other public lands where the VTP operates. Evaluating cumulative effects includes considering potential effects from multiple VTP projects, as well as similar projects on other public lands that could result in a substantial reduction in access to recreational areas.

Implementation of the VTP Proposed Program or any of the alternatives will not result in a measurable bioregional cumulative effect to recreation. No substantial increase in lands of severely reduced visual quality or access during the peak visitor season is detectable at the scale of the bioregion. VTP projects are expected to be relatively few in number and occurrence. For the Proposed Program, on an annual basis, 88% of watersheds within the program area will not receive any VTP treatments. For the 12% of watersheds that do support a VTP project, 98% of them will receive 3 treatments or less and most (83%) will only receive 1 treatment annually (Table 5.0.6).

Public recreational pursuits generally take place on State Parks, National Parks and Recreation Areas, National Forests, Bureau of Land Management lands, county parks, and other public lands. A cumulative effect could potentially occur where VTP project acres are adjacent to or within the same watershed as other land management activities in similar states of implementation and vegetation recovery that impact the recreational experience or opportunity. Given the expected distribution of VTP project acreage and number of projects conducted within a bioregion, it is highly unlikely that VTP projects (an average size of 260 acres) would combine with other land management activities to contribute to a cumulative impact to recreational experience, enjoyment, or access to facilities. Individual project effects to recreational values are considered negligible (Table 5.14.2) across all bioregions and methods of vegetation treatment. Land open to public recreation constitutes approximately 3.4 million acres in the 34 million acre CAL FIRE-VTP jurisdiction program area (10%). Annual acreage treated within the program area is expected to be about 217,000 acres over a ten year period. Project associated effects across all bioregions and considering all treatment methods would not close more than 1% of state park lands or other public recreational areas as a result of VTP treatments during peak visitor periods over a calendar year. Similarly, no severe reduction in visual quality is expected on state park or other public recreational area during peak visitor periods. VTP project effects to recreational resources are likely to be small scale, short term, and insignificant. From a cumulative effects perspective, at the scale of the bioregion, it is unlikely that short or long term changes in vegetation condition and recreational access associated with VTP projects would combine with other past, current or planned land disturbing management activities to produce a significant cumulative impact on recreational experience or access. VTP projects are not likely to exceed two weeks in duration. Similarly, prescribed fire is the most common treatment type and is not likely to occur during the summer and peak periods of public use.

There is a low likelihood that more than 10% of a given recreational area (state park, conservancy, etc.) would be treated in a single year, unless the recreational area was very small. Many recreational areas (state parks, conservancies, etc.) encompass parts of multiple watersheds and it is unlikely that all watersheds within a given recreation area would be intensively treated (>10% area) in a single year, therefore less than 10% of most recreational areas would be simultaneously treated. Similarly, when considering the likelihood of cumulative effects, many high use recreational areas on lands potentially subject to VTP projects (state parks, conservancies, wildlife management areas, ecological reserves, etc.) are not subject to significant land disturbing management activities related to resource extraction (timber harvest, mining etc.). These lands of limited or constrained land use further reduce the likelihood of a cumulative effect arising from implementation of a VTP project in concert with another land disturbing management activity that negatively affects recreational values or access.

In watersheds of mixed ownership (public-USFS/BLM and private CAL FIRE/VTP jurisdiction), VTP projects could occur simultaneously or sequential to other land disturbing activities. This scenario could result in a short-term cumulative effect to recreational value or access. Data are not available to evaluate the likelihood of the spatial and temporal relationship of VTP projects and those on public land at the bioregional scale. Although speculative, it appears unlikely that bioregional scale negative project impacts on recreational values or access would arise from the needed intersection of variables such as occurrence of crown fire vegetation type (tree and shrub), CAL FIRE jurisdiction within a project area of mixed ownership and of high recreational use, and of sufficient VTP and other land disturbance activity acreage of sufficient treatment intensity to produce a cumulative effect.

Prescribed fire can also provide maintenance and improvements to the visual aesthetics of recreation areas. Prescribed fire tends to open up forest stands and can increase the number and visibility of flowering plants (Wade, 1988; DeBano et al., 1998).

Determination of Significance

It is unlikely that VTP projects, under the Proposed Program or any of the alternatives, will result in closure of more than 1% of recreational areas where the VTP program can operate. Further, it is unlikely that similar projects on other public lands will occur at rate that would substantially decrease or degrade public recreational areas. In addition, VTP treatments can have longer term beneficial effects that may be cumulative if projects are in the same recreational area.

Mitigation(s)

- No mitigation necessary beyond those listed in Section 5.14.11.

6.4.11 Cumulative Effect - Biological Resources

This section discusses cumulative effect mechanisms or the types of effects that can occur under the VTP and related treatments from other vegetation treatment programs for terrestrial wildlife and plants, aquatic resources, and measures of riparian ecosystem function. Individual proposed project and alternative impact evaluations for wildlife, plant, and aquatic resources are discussed in Section 5.5. Included here is additional information that is relevant specifically to cumulative effects and the potential for the proposed project or alternatives to contribute to other land disturbing management practices that may result in a significant cumulative impact to terrestrial wildlife and plants, aquatic resources, and measures of riparian ecosystem function.

Overview of Cumulative Effect Potential

The environmental setting for biological resources is described in Chapter 4 (Section 4.5). Cumulative impact analysis specific to biological resources assumes that the number of acres subject to modification under the Vegetation Treatment Program and other land uses (timber production, grazing, development, and agricultural conversion (see Table 2.2) includes the maximum allowed under approved or Proposed Programs and the best estimates currently available.

Cumulative effects to biological resources could occur from fire hazard reduction, timber stand improvement and other vegetation treatment efforts included in the VTP when considered in the context of other existing and proposed land uses. The incremental contribution of the VTP to an evaluation of cumulative effects is determined by the number of acres treated annually under that program in combination with the acreage modified or expected by other land uses.

Plant communities, including the biological resources they support, potentially impacted by VTP activities have for the most part evolved under the influence of periodic fires of varying intensity, frequency, and size, and other agents of change. Change in California wildland (forests, woodlands, shrub and grasslands) disturbance regime as a result of settlement, resource extraction, plant species composition, and disturbance management (i.e., fire suppression) have significantly altered the ecological processes under which these plant and animal communities have evolved. Complicating these relationships is the fact that disturbance effects on biological resources vary depending on species vagility, time of year, and other aspects of their natural history.

For several reasons, biological resources and dynamics of plant community change present one of the more challenging areas to address with respect to cumulative effects determinations. For example, fire can have two markedly different effects on wildlife habitats. Large fires do not burn evenly and as a result produce a mosaic of vegetation and post-fire plant community succession. Alternatively, at a smaller scale, an intense stand-replacing fire can reduce habitat heterogeneity and foster a uniformity of food and cover value particularly in areas of similar slope, aspect, and soil type. Both outcomes may either be positive, negative, or exhibit no particular effect depending on the degree of habitat patchiness, the wildlife species of concern, and other topographic, climatic, and biological variables influencing fire effects. Thus, simple generalization of the effects of post fire or other disturbance induced habitat conditions and their implications for biological resources are not informative. Different species may be favored, negatively affected, or exhibit no particular response to the post fire or disturbance environment. While disturbance-caused modification of one habitat type into another may in many cases be “value-neutral,” in other cases, such as the loss or fragmentation of habitat for a threatened or endangered species, resource managers and the public may be very concerned about conversion of habitat type. For example, scientists have identified wildfire and its potential impact on the mature forest habitat of the California Spotted Owl as one of the biggest threats to the species.

Cumulative positive, neutral, or negative effects may also arise temporally. For example, vegetation treatments may be detrimental for some species in the short-term but lead to long-term improvements in habitat quality or help prevent other long-term detrimental effects such as habitat loss or change in plant community species composition from wildfire. In addition, impacts can be seasonal in nature depending on habitat use.

Overall, it is impossible to precisely specify at the scale of the state or region both the biophysical and economic ramifications of interaction between disturbance and biological resources. In the case of fire as an agent of disturbance, a number of experts have indicated that when one considers qualitatively the effect of fire (prescribed and otherwise) on biological resources, fire regimes, and wildland habitats at the scale of the state, it is likely that fire, at least over the short term, has had a net neutral if not beneficial effect (Sugihara et al., 2006). On the other hand, specific fires in specific places at specific times can have significant adverse effects on particular species and/or their habitat. Given the dynamic nature of vegetation and population response, these effects are of the greatest concern for species near the lower bound of population viability (i.e., state and federally listed species).

Cumulative effects occurring at the scale of the state or the region may not inform project level cumulative effects analysis. The checklist developed as part of the state or region wide cumulative effects analysis is designed to provide guidance to project scale cumulative effects analysis. Cumulative effects, either negative or positive, can potentially occur to individual species of concern, the distribution and sustainability of special habitat elements such as snags and down logs, wildlife disturbance issues as a result of project area access, change in vegetation structure, and other biological resources. Cumulative effects attributable to these kinds of impact mechanisms are generally most reliably assessed at the scale of the individual project and lands immediately adjacent. In some cases, information from larger regional studies is needed to supplement information on the local project area.

The programmatic VTP EIR cumulative impact analysis, conducted at the scale of the watershed or bioregion, identifies and assesses impact mechanisms that may influence landscape scale biological resource issues such as wildlife movement or habitat capability across broad regions, likelihood of genetic interchange, change in plant community composition as a result of non-native species establishment, or change in species distribution. Recognition of the scalar nature of assessment and management is not a new concept to existing resource management institutions. For example, the federal Endangered Species Act envisions the maintenance and recovery of ecosystems upon which Threatened, Endangered or Candidate species exist as the preferred approach over individual species management. Similarly, recognition of the interaction of human-altered or working landscapes and wildlands is central to the science of landscape ecology and the sustainability of biological diversity.

Riparian function encompasses a wide variety of processes (hydrologic, geomorphic, biotic) across a range of spatial and temporal scales. These processes interact to ultimately determine the character of the riparian zone and aquatic habitat quality. The metering of sediment, water flow, nutrients, organic matter, and structural complexity of the stream environment is a function of underlying geology, topography and condition of adjacent vegetation both near the stream and in upland environments. Vegetation management practices have the potential to alter these ecological processes directly within the riparian zone or indirectly through management of uplands. Vegetation management activities may result in or contribute to significant adverse effects to aquatic species through 1) changes in stream temperature, 2) increased sediment and other water quality parameters (e.g. dissolved oxygen, nutrients), 3) altered composition and abundance of fish, amphibians and other aquatic species, 4) increased stream bank erosion and streamside mass wasting, 5) reduction of in-stream structural complexity, 6) reduction in large woody debris recruitment and 7) altered peak and base flows. Strategies to address these potential adverse effects will vary regionally and protections or management of riparian zones is ultimately dependent on state and federal regulations in effect, site specific variation in vegetation composition, site-tree height, geology, slope, and other baseline conditions.

Cumulative Effects Analysis

The potential for cumulative effects arising from vegetation treatment program practices on water quality (e.g., sediment load, water temperature, and nutrient composition) are addressed elsewhere in this chapter. This section considers the recruitment potential of large woody debris, riparian canopy condition, and effects of vegetation management along the continuum of stream classification as a determinant of habitat quality for aquatic species, particularly salmonid and amphibian populations.

Fire as an example of a bioregional land disturbance agent and vegetation treatment tool

The following discussion of fire as a land disturbing agent as well as tool for vegetation treatment is included here to orient the reader to the predominant vegetation treatment method used in the VTP. Approximately 53% of the acreage treated annually under the Proposed Program and Alternatives 2 and 3 (115,000 acres), and 63% of treated acres under Alternative 1 (29,600 acres), will be completed with prescribed fire annually. Under Alternative 4, Minimize Air Quality Effects, approximately 8% of the acreage treated would be completed with prescribed fire (7500 acres) (Table 3.11).

It is generally recognized that the continued health and integrity of fire-adaptive habitats depends, in part, on our ability to understand the ecological role of fire, the effects of changes in fire regime on ecosystem structure and function, and management practices designed to mitigate negative effects to negligible or less than significant levels. Our ability to implement those management practices will ultimately depend on policy and management decisions about balancing tradeoffs among issues of public safety, environmental protection (e.g., air quality), and long-term ecosystem health/ management.

The fire regime changes currently of greatest concern to the fire protection community are those that pose risks of catastrophic fires to life and property, and some natural resources. These include many areas where the occurrence of low intensity fires has been successfully reduced through fire protection practices, and so fuels have built up. While Sierra Nevada westside forests and southern chaparral offer prominent examples of the effects of fire regime changes, the exclusion of fire may be causing similar or more gradual changes in other habitats as well, where they pose less threat to public safety but may still threaten the long term health or viability of plant and wildlife habitats. Finally, other habitats may be threatened by changes in fire regimes that result in more - rather than less - frequent fires, and drive habitat type conversions or increases in non-native species (Keeley et al., 2011) (e.g., eastside pine/bitterbrush or transition zones). In sagebrush steppe plant communities large fires of sufficient intensity that result in a type conversion may result in a cumulative effect to wildlife. While rate of juniper and other encroaching species may be slowed as a project objective, it is also likely that habitat conditions conducive to the establishment of non-native grasses are also produced. Development of project level management measures and implementation methods are necessary to minimize likelihood of type conversion. Sagebrush obligate species population recovery (e.g., Sage Grouse) is unlikely in areas of shrub to grass conversion.

The potential ecological effects of fire regime changes - and our management practices for mitigating them - are further compounded by scale and pattern of the affected habitat. For areas that are limited in size, fragmented in distribution, or contain rare or endangered plants or animals, a wildfire or any disturbance may result in short-term or even permanent negative effects that we would not otherwise be concerned with in fire-adapted environments. These landscape constraints may increase their vulnerability to loss and decrease their inability to recover from either catastrophic wildfire or certain types of pre-fire treatments used to "protect" them. While these relationships are complex, the concepts need to be articulated in a way that promotes comprehensive approaches to management and protection, brings in the appropriate range of disciplines, and avoids one-size-fits-all pre-fire management prescriptions.

The Sierra Nevada Ecosystem Project (SNEP, 1996) determined that the lengthening of fire return interval in mixed conifer forests of the Sierra Nevada has a strong likelihood of engendering higher intensity fires than would be expected under a natural fire regime. Higher intensity fires threaten a number of important ecological features, particularly late successional forest, as well as important economic resources, such as timber and structures. While several agencies have proposed to expand prescribed burning by an order of magnitude in the Sierra and therefore supposedly replace high intensity wildfires with low intensity prescribed fires, it is certain that wildfire, rather than prescribed fire, will characterize the fire regime of the Sierra for decades to come. While wildfires, particularly those portions with low intensity, may perform several key ecological functions and therefore be preferred to no fire whatsoever, it remains important to mitigate the effects of unnaturally high levels of high intensity fires in order to conserve key structural characteristics such as large, old trees and snags that have otherwise become relatively rare in the Sierra.

Reducing the extent of stand terminating events, particularly in late successional stands, while simultaneously allowing or promoting low intensity wildfire, was identified by SNEP (1996) as a key strategy in the restoration and management of Sierra Nevada forests.

Significance Criteria

1A. Potential to have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a listed, candidate, sensitive or special status species in local or regional plans, or regulations, or by CAL FIRE, DFG, US Fish and Wildlife Service, or National Marine Fisheries Service (see Section 5.5 *Biological Resources*).

1B. Reduce the number or restrict the range of a rare or endangered plant or animal.

1C. Interfere substantially with the movement of any native resident or migratory species or with established native resident or migratory species corridors, or impede the use of native species nursery areas; and permanently alter the habitat value of established wildlife corridors.

1D. Conflict with the provisions of an adopted Habitat Conservation Plan (HCP), or other approved local, regional or State HCP.

1E. Cause a population to drop below self-sustaining levels or threaten to eliminate a terrestrial plant or animal community.

1F. Create conditions favorable to the establishment or expansion in range of invasive non-native species.

1G. Result in a substantial reduction in the occurrence, quality or sustainability of habitat elements such as snags or down logs in the terrestrial environment.

Cumulative Effects Analysis

Additional Aquatic and Riparian Function Specific Impact Criteria

1H. Substantial alteration of sediment or heat inputs to the aquatic environment or floodplain and riparian areas particularly in watersheds listed as sediment or temperature impaired under Section 303(d) of the federal Clean Water Act.

1I. Short or long-term reduction of large woody debris recruitment and delivery potential.

1J. Substantial reduction in stream bank stability.

1K. Reduction of headwater or spring/seep environments to function as amphibian habitat or provide sediment retention, nutrients, and woody debris to downstream environments.

1L. Substantial reduction in forest canopy nutrient input to stream systems.

Determination Threshold

No unique thresholds beyond those presented in Chapter 5 (Sections 5.5.1, 5.5.2, 5.5.3) were considered.

Setting for Cumulative Effects Evaluation

For a variety of ecological questions and conservation issues, a regional scale analysis like that done for this document can provide guidance to examine trends and, when data is available, spatially explicit landscape design concepts. For other questions and conservation issues, more detailed analysis is necessary and must be carried out at the scale of the watershed or other planning unit (Urban et al., 1987). The regional or programmatic scale disclosure provided within this document is intended to examine the likelihood of a bioregional or statewide cumulative effect, but also to provide context to the determination of cumulative effects at the project scale. Project scale cumulative effects analyses may make findings specific to project level implementation that support or disagree with those made at the programmatic scale.

County based bioregions were used to determine percent ground disturbance attributed to both current and future conditions under the proposed VTP and the relative contribution of the proposed VTP to other similar ground disturbing programs. The analysis assumes that historic ground disturbing activities and acreage affected will continue at a similar rate in the future. Vegetation acreage is limited in extent to those types potentially treated. Additionally, no attempt was made to account for the relative differences in the rate of recovery that is specific to the type of vegetation treated. For example, grass dominated systems frequently attain pre-project conditions in less than 5 years while other vegetation types may take markedly longer to attain pre-project conditions.

County based bioregions do not share the same boundaries as the ecologically derived bioregions used in Chapter 5 and therefore total bioregion acreage will differ from that analysis. Federal and state databases tracking treated acres are not consistent in their reporting at scales larger than the county. Alternatives 2 and 3 would be implemented at the program acreage cap of 2,500,000 acres per decade and would result in a comparable estimate of area disturbed to that of the Proposed Program. Alternative 1 (status quo) would be implemented at a program cap of 47,000 acres per year over a decade, and Alternative 4 (air quality) operates with a cap of 93,000 acres per annum over the same period. Both of the latter alternatives would result in less ground disturbance than the Proposed Program or Alternatives 2 or 3.

Cumulative Effects Analysis

Statewide, annual VTP acreage disturbed is about 2% above that occurring as a result of other major but similar ground disturbing events (Table 6.2.11). At the scale of the bioregion, annual VTP acreage disturbed ranges from 0% in the Colorado Desert to 0.05% in the Central Coast Bioregion (Table 6.2.11).

From the scale perspective of a programmatic bioregional assessment of cumulative effect, the amount of acreage eligible but not receiving treatment under the VTP would likely result in a negligible or deminimus cumulative effect on biological resources. Wildfires would continue to occur in California having both negative and positive effects on biological resources and wildlife habitat condition; the magnitude of effect being dependent on a wide suite of physical and biological variables controlling that ecosystem driver.

It is unlikely that sufficient acreage can be treated under the VTP as proposed to result in a measurable cumulative impact over the no treatment option when assessed at the scale of a bioregion.

There may indeed be potential adverse effect to small scale biological resources (e.g. hot spots, rare plants, etc.) that occur at a localized scale that will need to be addressed at the project level and incorporated through the use of an environmental checklist and consultation with subject matter experts as needed. In general, VTP treated acreage will not be extensive enough or result in significant alteration of treated vegetation types to result in a negative cumulative effect to wildlife species when the VTP contribution to that cumulative effect is considered with other land management activities, implementation of project level mitigation, management and environmental checklist measures, and when assessed at the scale of the bioregion. Indirect effects of desired fuel condition and vegetation regeneration diminish over time as treated areas, in the absence of retreatment or wildfire, recover pretreatment vegetation structure. Rate of change is dependent on a large number of environmental variables and short or long term effects on a given species are similarly variable.

VTP projects that result in an extensive or long term or permanent type conversion are most likely to result in a measurable or significant contribution to negative cumulative effects to the wildlife community. VTP projects implemented in grass and forb dominated plant communities generally return to pretreatment conditions within a few years although change in species composition is a concern at the scale of the project (Keeley et al., 2011). Long term or permanent type conversion is most likely in shrub dominated plant communities that are not fire adapted and/or are vulnerable to establishment and expansion of competing non-native species post treatment. Conversion of shrub dominated habitat, may in conjunction with other similar shrubland disturbing land use effects, result in a negative cumulative effect on shrub dwelling fauna. VTP projects in tree dominated communities typically focus on modification of midstory or understory vegetation structure or alteration of tree overstory canopy closure levels. Historically, invasion of invasive plants following site disturbance has been less common in higher elevation forests it is of potential concern and could become more common under warmer climate scenarios (Keeley et al., 2011).

However, the likelihood of multiple projects occurring in the same watershed or otherwise in close proximity temporally and thus contributing to a significant "cumulative effect" is very low given the small number of possible VTP projects in shrubland habitats sharing these characteristics and when assessed at the scale of the bioregion. Cumulative effect identification and development of appropriate mitigation or management measures, including avoidance, is most effectively done at the scale of the project when the spatial and temporal juxtaposition of multiple project effects can be evaluated.

The following section evaluates potential cumulative effects to biological resources arising from implementation of the Proposed Program or the alternatives. The potential for a cumulative effect is discussed for each impact criterion.

6.4.11a Cumulative Effects Potential – Criterion 1A

Potential to have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a listed, candidate, sensitive or special status in local or regional plans, or regulations, or by CAL FIRE, US Fish and Wildlife Service, or National Marine Fisheries Service.

Determination of Significance – Criterion 1A

Pre-project scoping at the scale of the project and, if necessary, implementation of surveys to determine presence will assess the likelihood of project level impact to species of concern. Implementation of Minimum Management Requirements and other mitigation or planning measures will further provide for the protection of plant and animal species of concern. When considered at a bioregional or programmatic scale, the small amount of acreage treated, recovery potential of plant communities treated, and project specific planning processes and mitigations (in combination with other land disturbing activities and mitigative measures at the bioregional scale) results in a deminimus or negligible VTP contribution to cumulative effects. For example, the Proposed Program annual treatment acreage for each of California's Bioregions ranges from 0.06% in the Mojave Bioregion to 2.0% in the Sacramento Valley Bioregion (Table 2.4). Additionally, the average annual amount of disturbed acreage by county based on bioregion and inclusive of similar land disturbing activities on federal, state and private lands range from an average annual 0.0 % in the Colorado Desert Bioregion to 1.41% in the South Coast Bioregion (Table 6.2.11). The cumulative impact of VTP with other related actions is considered less than significant with adopted implementation and mitigation measures.

6.4.11b Cumulative Effects Potential – Criterion 1B

Reduce the number or restrict the range of a rare or endangered plant or animal.

California is the most biologically diverse state in the contiguous United States, and has the largest state population. As a result, threats to the continued existence of native species and the natural communities on which they rely are also increasing.

Taxa listed in Table 6.4.5 are composed of species, subspecies, distinct populations, or evolutionary significant units that appear on either the federal or State ESA or are listed under both acts. The number of listings continues to rise, increasing from 195 taxa in 1987 to 444 in 2009 (Table 6.4.5).

Table 6.4.5
Cumulative Number of Officially Listed* Taxa, 1987 to 2009**

Year	Plants	Gastropods	Crustaceans	Insects	Fish	Amphibians	Reptiles	Birds	Mammals	Total
1987	118				18	8	9	20	22	195
1990	215	1	2	12	18	8	9	26	25	316
1993	218	1	2	13	18	8	13	28	26	327
2000	254	2	8	20	26	10	13	28	28	389
2009	282	4	8	23	33	15	13	30	36	444

**Official listed animal species refers to state listed as threatened or endangered (T&E), federally listed as T&E or on both the state and federal list as T&E Official listed plant species refers to those that are state listed as threatened, endangered, or rare (TE&R), federally listed as T&E, or both state and federally listed as T&E.*
***Includes species, subspecies, distinct populations, Evolutionary Significant Units (ESU).*
Source: California Department of Fish and Game. 2009. Threatened and Endangered Species.
http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/index.html

Determination of Significance – Criterion 1B

Wildfires typically influence markedly greater amounts of acreage than that to be treated under the proposed VTP or any of the alternatives. The likelihood of reduction in number or distribution of plant or animal species of concern is potentially markedly higher under large and uncontrolled land disturbance events like those arising from wildfire. Effects of wildfire are varied and include influence on animal movements, direct mortality, seed dispersal, enhancement of habitat for non-native invasive species. Over the past eight years, 97.6% of the total acreage burned in wildfires was the result of fires greater than 300 acres in size. A total of 33 wildfires in a variety of vegetation types exceeded 10,000 acres in size from 1997 to 2006. VTP projects are unlikely to reduce the number or distribution of plant or animal species of concern as assessed at the scale of the bioregion. VTP program contributions to cumulative effects of land disturbing events that reduce the number or range of species of concern is negligible and may result in an overall but immeasurable beneficial effect to the degree that wildfire events are reduced in frequency, extent or intensity. The cumulative impact of VTP with other related actions is considered less than significant with adopted implementation and mitigation measures.

See also Determination of Significance Criterion 1A

6.4.11c Cumulative Effects Potential – Criterion 1C

Interfere substantially with the movement of any native resident or migratory species or with established native resident or migratory species corridors, or impede the use of native species nursery areas.

The ability of wildlife to move across the landscape is essential to long-term sustainability of populations and the maintenance of regional biological diversity. In environments that are heavily impacted by urbanization or agricultural land uses, the pattern of habitat loss, associated habitat fragmentation, and disruption of movement patterns has a marked influence on ecosystem processes (Forman, 1997). Conserving well-connected networks of large wildland areas where ecological and evolutionary processes function over large spatial and temporal scales requires adequate landscape connections. Establishing or maintaining linkages between areas of wildland is a well-recognized tenet of conservation biology and positively influences the ability of wildlife populations to respond to stochastic environmental influences such as fire, flood, or non-native species as well as longer term directional effects such as climate change, and maintains long term population viability above that of otherwise isolated wildlife populations.

Countering the effects associated with habitat loss and fragmentation at the landscape scale requires a systematic approach for identifying, protecting, and restoring functional connections. For example, early regional conservation planning for the Northern Spotted Owl identified landscape scale linkages and hypothesized habitat conditions between population centers necessary for successful movement and subspecies interaction (Thomas et al., 1990). Similarly, the South Coast Missing Linkages Project (Penrod et al., 2003) identified 15 areas where habitat retention was necessary to maintain movement patterns of focal wildlife species across the landscape.

Landscape scale corridor identification or other areas of reproductive importance (nursery areas) are typically an element described in species conservation planning documents such as Habitat Conservation Plans, Recovery Plans, and Natural Community Conservation Plans (see Cumulative Effect Potential Criterion 1D).

Determination of Significance – Criterion 1C

Land disturbance activities resulting from any of the vegetation treatment options have the potential to alter the habitat suitability of identified landscape linkages, making them unsuitable for movement of certain focal species. Cumulative and direct and indirect effects to landscape linkages are a determination made at the scale of the project as described in the project check list. Alternatively, these same practices have the potential to protect linkages from catastrophic loss or enhance habitat value within those landscape scale features. As assessed at the scale of the bioregion, VTP effects are expected to be negligible or immeasurable. VTP program contributions to cumulative effects of land disturbing events that interfere substantially with the movement of any native resident or migratory species or with established native resident or migratory species corridors, or impede the use of native species nursery areas is negligible. The VTP may result in an overall but immeasurable beneficial effect to the degree that wildfire events are reduced in frequency, extent or intensity. Based on average size of VTP prescribed burn project area (260 acres), frequency of occurrence, and expected spatial distribution, the cumulative impact of VTP with other related actions is considered less than significant with adopted implementation and mitigation measures when assessed at the scale of a bioregion.

6.4.11d Cumulative Effects Potential – Criterion 1D

Conflict with the provisions of an adopted Habitat Conservation Plan (HCP), or other approved local, regional or State habitat conservation plan.

Natural Community Conservation Plans (NCCP) authorized under California's Natural Community Conservation Planning Act and Endangered Species Act, as well as Habitat Conservation Plans and other planning vehicles provided for under the federal Endangered Species Act are being increasingly used in California as a means to conserve species of concern and ecosystem processes; as well as providing for incidental take und ESA and CESA. As additional acreage of wildland and urban-rural interface lands are enrolled under these planning efforts, the potential for off-site and indirect cumulative effects also increases. There are 39 active (approved and implementing or in planning phase) NCCPs covering more than 32 million acres of which 23 have been approved and permitted. The NCCP for the Desert Renewable Energy Conservation Plan alone covers 23.4 million acres. As of April 2012 a total of 133 HCPs had been completed, and 6 additional plans are in review, having submitted permit applications. Several other types of conservation agreements are also possible (http://ecos.fws.gov/conserv_plans/public.jsp) to address species listed under the federal ESA and within California, including 10 Safe Harbor Agreements, 9 Candidate Species Conservation Agreements, and one Candidate Species Conservation Agreements with Assurances.

The NCCP program of the Department of Fish and Game is an unprecedented effort by the State of California and numerous private and public partners that takes a broad-based ecosystem approach to planning for the protection and perpetuation of biological diversity. An NCCP identifies and provides for the regional or area wide protection of plants, animals, and their habitats. The primary objective of the NCCP program is to conserve natural communities at the ecosystem scale while accommodating compatible land use. The program seeks to anticipate and prevent the controversies and gridlock caused by species' listings by focusing on the long-term stability of wildlife and plant communities and including key interests in the process.

The NCCP program is a cooperative effort to protect habitats and species. The program, which began in 1991 under the State's Natural Community Conservation Planning Act, is broader in its orientation and objectives than the California and Federal Endangered Species Acts. These laws are designed to identify and protect individual species that have already declined in number significantly.

Habitat Conservation Plans (HCPs) are long-term agreements between an applicant and the U.S. Fish and Wildlife Service and/or NOAA National Marine Fisheries Service. They are designed to offset any harmful effects that a proposed activity might have on federally-listed threatened and endangered species. The HCP process allows development to proceed while providing a conservation basis to conserve the species and provide for incidental take. The purpose of the habitat conservation planning process and subsequent issuance of incidental take permits is to authorize the incidental take of threatened or endangered species, not to authorize the underlying activities that result in take. This process ensures that the effects of the authorized incidental take will be adequately minimized and mitigated to the maximum extent practicable.

Determination of Significance – Criterion 1D

VTP projects will as part of project planning and checklist compliance, review applicable local and regional HCPs. Conflicting objectives will be identified at the project level and resolved through coordination with appropriate State or federal fish and wildlife agencies. In addition, opportunities to further the objectives of local and regional conservation plans through vegetation treatments conducted under the VTP will also be identified and implementation coordinated through appropriate State or federal fish and wildlife agencies. Therefore, the cumulative effect of the VTP, with related programs, will not significantly conflict with established conservation programs or plans. The cumulative effects are less than significant and potentially beneficial.

6.4.11e Cumulative Effects Potential – Criterion 1E

Cause a population to drop below self-sustaining levels or threaten to eliminate a terrestrial plant or animal community.

Terrestrial wildlife and plant populations can be extirpated or fall to levels where formal listing is warranted if habitat conditions are degraded to a point that populations are no longer self-sustainable. However, it is unlikely that VTP treatment acreage in conjunction with other similar programs and vegetation treatment efforts will be sufficiently extensive and concentrated in time and space to threaten population sustainability or eliminate a plant or animal community. Statewide, average annual acreage disturbed by the VTP is 0.64% above that occurring as a result of other major but similar ground disturbing activities including wildfire (Table 6.2.11). Cumulatively, and by county based bioregions, the percent of disturbed acreage potentially added by the proposed VTP ranges from 0% in the Colorado Desert Bioregion to 0.05% in the Central Coast Bioregion. When all similar ground disturbing acreage (excluding wildfire) is included the average annual future percentage of disturbed acreage ranges from 0% in the Colorado Desert Bioregion to 1.4% in the South Coast Bioregion (Table 6.2.11).

Significant cumulative direct and indirect effects on listed, sensitive, and common species are not expected to occur for several reasons.

- The potential for cumulative direct and indirect effects is minimal given the small average size of VTP projects (260 acres) and low likelihood of temporal and spatial adjacency to similar effects from non-VTP management efforts.
- Implementation of avoidance and other mitigative measures to eliminate direct effects or reduce indirect effects to a negligible or less than significant on special status species at the scale of the project. Similar avoidance measures and mitigations are routinely employed by other agencies as required by statute and through environmental review.
- Species considered common and terrestrial plant and animal communities will not experience sufficient cumulative habitat alteration from the VTP and other similar vegetation treatment programs to threaten plant or wildlife population or community sustainability given the spatial and temporal limits described above. In addition, to management and mitigative measures that address certain species, habitat types, and landscape features; duration of cumulative effect is further ameliorated by recovery and reoccupancy rate of populations and habitat structure. Rate of response will vary by species and pre-treatment vegetation structure, condition of untreated or adjacent habitat, and treatment method. However, the Schedule of Treatment Maintenance (See Section 2.5 G) provides one broad measure of rate of habitat recovery at the level of the lifeform. Grasslands would again be candidate for treatment in as little as 3 years after the initial treatment. Shrublands and forestlands (given treatment of the shrub component of the latter) may again be suitable for treatment 10 to 30 years after the initial treatment; it is highly variable depending site conditions.

Determination of Significance – Criterion 1E

As described in Chapter 5, no terrestrial wildlife or plant populations are expected to drop below self-sustaining levels as a result of VTP implementation. Similarly, no terrestrial community will be eliminated. Analysis of the direct and indirect effects associated with the proposed VTP and alternatives concluded that for representative species of concern, no alternative would result in a significant adverse effect after application of identified mitigation measures. The cumulative impact of VTP with other related actions is considered less than significant with adopted implementation and mitigation measures when assessed at the scale of a bioregion. In general, conditions for terrestrial and aquatic species are expected to show continued improvement over time as plant communities are incrementally protected from the effects of unnaturally intense wildfire and as plant communities adapted to periodic fire are reintroduced to this important driver of ecosystem processes.

6.4.11f Cumulative Effects Potential – Criterion 1F

Create conditions favorable to the establishment or expansion in range of invasive non-native species.

The introduction of exotic species can be a serious threat to native plant and animal communities. Invasive non-native species alter ecosystem structure, composition, and processes and out-compete and exclude native plants and animals. Those non-native species that have successfully established themselves and expanded their range in California's diverse environments have had far reaching effects. These effects include direct competition or hybridization with and subsequent exclusion of native species, and also as an agent for the change of ecosystem function. Ecosystem effects include alteration of disturbance regimes, such as frequency and intensity of fire and potential changes in soil erosion rates.

Invasive plant species generally exhibit certain characteristics that make them effective competitors and which facilitate their establishment and dispersal. These include large numbers of easily dispersed seed, ability to reproduce by both seed and vegetative growth, and ability to persist under variable environmental conditions such as dry or wet soil conditions. Geographically separate biological regions now share an increasing number of species in common. Invading non-native species that are successful at establishing viable populations are generally symptomatic of landscapes and ecosystems that have been altered or exhibit a marked reduction in some of their original productive capacity.

Ecologists increasingly recognize that ecosystems are dynamic in nature—that change is the predominant and common feature. Rates of change may vary with time and are expressed by differences in species densities and occurrence such that composition of any ecosystem is not static. Opportunities for invasive species to successfully establish themselves and expand their distribution are enhanced during periods of rapid ecosystem change.

In some cases the rate of spread, once successfully established, has been exceptionally rapid. Three examples of rapidly spreading plant species are yellow starthistle (*Centaurea solstitialis*), cheat grass (*Bromus tectorum*), and scotch broom (*Cytisus scoparius*). Yellow starthistle has expanded its range in California from 1.2 million acres in the late 1950s to 15 million acres in 1999 (Pitcairn et al., 1998; Maddox et al., 1996; Bossard et al., 2000; DiTomaso, 2005). Cheat grass, following its introduction in the late 1800s, now dominates much of the western United States and the eastern slope of the Sierra Nevada. This species, given its rapid maturation, short green period, and domination of disturbed sites has low value as a forage plant and reduces rangeland productivity. Cheat grass in shrub/grass plant communities also provides a fuel source that increases fire hazard. Scotch broom in coastal and foothill regions now covers more than 618,000 acres and has displaced native vegetation. This aggressive weed is of little value to wildlife. Roadways provide both the disturbance needed for establishment and corridors for dispersal. Scotch broom is expected to continue to expand its range with the increasing rate of rural development (Schwartz et al., 1996).

Change in land use is generally associated with alteration of ecological processes. As such, it provides a medium for the introduction, successful establishment, and expansion of non-native plant and animal species. Disturbance is a natural part of ecosystem function in many systems. However, society's large-scale alteration of the type and frequency of disturbances results in changed ecosystem states and increased opportunities for invasive species establishment, to the general detriment of native species (Hobbs, 2000). Plant communities vary in response to fire but in general, fire suppression leads to an accumulation of fuels and increased burn intensity, resulting in a greater level of disturbance and opportunity for establishment of non-native invasive plant species. VTP objectives and those of other similar programs are to reduce fuel accumulations and potential for large scale disturbance events and conditions suitable for establishment of invasive species.

Several State and federal programs are actively working to identify and control the introduction and successful establishment and spread of non-native invasive species in California (http://www.cdfa.ca.gov/phpps/ http://www.cdfa.ca.gov/phpps/ipc/ http://www. ipm.ucdavis.edu/). The California Department of Food and Agriculture and the California Invasive Weed Awareness Coalition have recently developed an action plan to address noxious and invasive weeds in California (http://www.CAL FIREa.ca.gov/phpps/ipc/noxweedinfo/pdfs/noxious weed plan.pdf). The primary purpose of the plan is to enhance existing protection efforts, coordinate weed control activities and ensure cost effectiveness, and partner with federal weed control agencies.

Determination of Significance – Criterion 1F

Land disturbance activities resulting from any of the VTP vegetation treatment options and other cumulative action have the potential to create or enhance land conditions that facilitate the establishment or spread of non-native invasive species. Although treated acreage within the VTP Proposed Program and alternatives is low relative to other land disturbing management activities at the bioregional scale, range expansion of non-native invasive species into new areas could, considering difficulty of plant control and area affected, result in a significant cumulative effect. VTP management actions may also decrease the frequency, extent or severity of wildfire and as a consequence the extent of disturbed landscape available for establishment of non-native invasive species. Similarly, VTP projects can be developed to specifically target non-native invasive weed infestations as part of larger invasive plant control efforts. Project level mitigation and management practices are designed to reduce the probability of introduction, establishment, and spread of non-native invasive species. These practices include washing vehicles prior to entering a site for treatment, minimization of ground disturbance, treatment timing depending on plant composition of the treatment site, pre-project survey, and post project monitoring and follow-up action as appropriate. When assessed at the scale of the bioregion, VTP contributions to the cumulative effect of land disturbing events that create conditions favorable to the establishment or expansion in range of invasive non-native species is negligible. The VTP may result in an overall but immeasurable beneficial effect to the degree that infestations are controlled as a project objective or wildfire events are reduced in frequency, extent or intensity. However, there are other cases where disturbance from fire treatments allows for introduction or colonization from non-native species (Keeley et al., 2011). The cumulative impact of VTP with other related actions is considered less than significant with adopted implementation and mitigation measures.

6.4.11g Cumulative Effects Potential – Criterion 1G

Result in a substantial reduction in the occurrence, quality or sustainability of habitat elements such as snags or down logs in the terrestrial environment.

Timber management activities on public and private forest lands have altered the structural characteristics of a number of forest habitats. The conversion of old-growth forests to rapidly growing but structurally simpler younger forests is a notable example. Generally, the goal of intensive timber management is to reduce the amount of time required to produce a new crop of trees. Shortening or eliminating certain pathways of forest succession that are dominated by grass, shrubs, or hardwoods can be associated with this objective. Management of forestlands for timber production frequently alters forest structure from multi-aged stands of mixed species in patch sizes determined by natural events, to young, even-aged stands with reduced tree species diversity.

Snags (standing dead trees) and down logs (portions of or entire trees that have fallen to the ground) have been shown to have significant positive habitat value for many plants and animals, and are considered “special habitat elements”. This term refers to specific physical and biological attributes of the landscape without which certain species either are not expected to be present or will exist in greatly reduced numbers (Mayer and Laudenslayer, 1988). Intensive management that concentrates on the production of wood products can make it difficult for resource managers to provide many of the diverse structural components such as snags and down logs desired to support biological diversity. Repeated logging over relatively short time periods and reforestation and other activities may accelerate the loss of snags, reduce new snag and down log recruitment, and decrease the likelihood of trees becoming large enough to provide the habitat required by some species. Snags, down logs, and the capability of the land to produce these elements over time are of particular concern because adequate numbers, size, and decay classes of these habitat elements are required for the long-term persistence of dependent wildlife species.

The benefits of down logs are many, including their contribution to forest soil nutrient levels and habitat for a large number of plant and animal species. Logs found on the forest floor as well as within or adjacent to streamsides are key structural elements to terrestrial and aquatic ecosystem function. Over time, trees become part of the down-wood component of the forest floor or aquatic environment. Forest stand characteristics then are ultimately responsible for the species, size, and recruitment rate of down logs.

Wood utilization standards employed by forest managers, as well as a variety of economic considerations that influence merchantability, also affect the degree to which snags and down logs are retained (Spies and Cline, 1988). For example, in the intensively managed forest plantation, establishment is generally preceded by the removal of coarse woody debris that includes down log accumulations that were present prior to logging.

Other differences exist between forests managed intensively for wood products and those that provide multiple uses. Harvest cycles occurring over short periods of time, as when a forest is thinned at regular intervals, minimizes the accumulation of down logs, and produces smaller diameter trees that decay faster than larger diameter material. Large plantations also reduce the input of coarse woody debris that alters the functional characteristics of the forested environment. Significant reductions in the amounts of coarse woody debris and down logs, below desired levels, impair habitat value, forest productivity, and biological diversity (Spies and Cline, 1988). A variety of forest management practices are available to recruit snags and down logs. These include retaining green trees adjacent to or within a stand scheduled for harvest and maintaining areas as part of a longer rotation, thus allowing trees to reach not only a desired size but also desired structural attributes.

Plot data from the United States Forest Service (USFS) Forest Inventory and Analysis (FIA) program was used to describe the abundance and characteristics of snags and down logs in a variety of California forest types and ownership categories. Currently available snag and down log levels reflect conditions as of 2000 for public lands while private land data was collected between 1991 and 1994. Although plot data collected on National Forest reserve lands is more recent than that on private lands, snag and down log densities are assumed (for the purposes of the comparative analysis) to not have markedly changed on reserved ownerships during the intervening time period.

Comparing current densities of snags and down logs versus “historic” or “natural” levels can be problematic since historic information is only a snapshot of the conditions of that period. As such, the reference period is only a point in time within the natural range in variation of snag and down log densities and may not be representative of the historic reference period. In addition, there are few if any baseline reference areas from which to adequately sample and measure “naturally” occurring snag and down log densities and recruitment processes that have not been influenced by fire exclusion and historic management policies. Comparative historic data describing these structural attributes in forests of the nineteenth century are limited, but some case studies exist (Gruell, 2001; Skinner, 2006).

In general, Private Industrial and Private Non-Industrial lands have 40 percent fewer snags of all size and decay classes than are found on National Forest reserve lands (3.7 per acre versus 6.2 per acre). The relative abundance of large snags across ownerships and management emphasis is also noteworthy. Private Industrial and Private Non-Industrial ownerships possess 70 (0.3 snags per acre) and 80 (0.2 snags per acre) percent fewer snags of greater than 30 inches DBH, respectively, than do National Forest reserve lands. On National Forest reserve lands (as an ownership class) approximately 17 percent of all snags are in the largest size class, Private Industrial and Private Non-Industrial retain eight and five percent, respectively. Overall, these averages suggest that snag densities are markedly less on private versus National Forest reserve lands.

When compared to down log densities on National Forest reserve lands, those on private lands exhibit markedly higher densities. Private Industrial lands carry a high level of total down logs per acre (35.4 down logs per acre) when compared to other ownerships. Statewide, they possess down log densities 65 percent higher across all log sizes and decay classes than those on National Forest reserve lands (12.4 down logs per acre). Similar elevated percentages relative to National Forest reserve lands are apparent when examining only large log densities on Private Industrial lands (4.4 down logs per acre) (64 percent) or a combination of medium (17.4 down logs per acre) and small (13.6 down logs per acre) log densities (65 percent). On the National Forest reserve land ownership class, 13 percent of all logs are in the largest size class (1.6 per acre), whereas Private Industrial and Private Non-Industrial ownerships show 12 percent (4.4 down logs per acre) and seven percent (0.7 down logs per acre) respectively. Down log densities of all size classes and within all forest types sampled on Private Industrial lands exceeded densities found on National Forest reserve lands by a large margin.

Cumulative Effects Analysis

Determination of Significance – Criterion 1G

Project alternatives that utilize prescribed fire as a vegetation treatment method have the potential to influence the retention of existing snag or down log densities. Depending on prescribed burn fire intensity, snag or down log size and location in treatment units, topography, and other site specific conditions, degree of consumption of these forest features by fire is also variable. Similarly, the sustainability of these types of forest structure over time is dictated by silvicultural practices and other environmental conditions that influence retention rate of green trees of sufficient size to achieve desired snag and down log characteristics and densities.

Cumulative and direct and indirect effects to the quality and frequency of occurrence of these forest structural elements are determinations made at the scale of the project. Because plot sizes represent large areas ranging from hundreds to thousands of acres per plot, information is best used at bioregional or statewide scales and may not be applicable or reliable for any one forest stand. Variation among plots taken to measure snag and down log densities is generally high, particularly when small numbers of plots are considered or results are applied at small scales, such as the forest stand or a small watershed. Similarly, in landscapes of mixed ownership, snag and down log densities may be well represented when considered independent of ownership class.

Comparing current densities of snags and down logs versus “historic” or “natural” levels can be problematic since historic information is only a snapshot of the conditions of that period. As such, the reference period is only a point in time within the natural range in variation of snag and down log densities and may not be representative of the historic reference period. In addition, there are few if any baseline reference areas from which to adequately sample and measure “naturally” occurring snag and down log densities and recruitment processes that have not been influenced by fire exclusion and historic management policies. Comparative historic data describing these structural attributes in forests of the nineteenth century are not available.

There are a variety of factors potentially responsible for the differences in snag and down log densities between National Forest reserve and Private Industrial or Private Non-Industrial lands.

- Different cutting practices on private lands were prevalent during the period from 1984 through 1994 in which plot data were collected. These practices may have resulted in higher levels of down log and woody material retention on the forest floor as a result of difficulties associated with its effective removal while protecting trees remaining onsite after harvest.
- Management policies on public lands include an active woody debris treatment program that reduces forest fuels as well as the amount of wood on the forest floor. Snag size and relative density could be expected to be higher on managed public lands given a concerted effort by managers to retain those elements along with a generally greater density of large sized live trees that provide snag recruitment to the larger size classes.
- Private lands generally exhibit a greater efficiency at salvaging tree mortality as merchantable harvest volume. This capability also reduces actual and potential snag density levels on private lands managed principally for wood fiber production.
- Utilization practices on private lands, regarding both live trees and salvage operations, concentrated on large tree removal and likely bypassed smaller trees during earlier decades.

As such, higher levels of down logs resulting from previous utilization practices were expected on private land when sampled during the early 1990s.

With project level management and mitigation measures in place and as assessed at the scale of the bioregion the cumulative effects of VTP treatments and related activities on snag and down log densities are expected to be negligible or immeasurable. The cumulative effects are considered less than significant and no further mitigation additional to that implemented at the scale of the project is required.

Cumulative Direct Effects of Herbicides to Wildlife and Botanical Resources

Section 5.17 summarizes the environmental and human health effects arising from herbicide use under the Proposed Program or the Alternatives. This section discusses the cumulative direct effects of herbicide use on wildlife and botanical resources separate from the indirect effects of habitat alteration addressed above. Under the Proposed Program a total of 19,600 acres could be treated annually with lesser acreage treated depending on Alternative (Table 5.17.3). The acreage reported includes the use of herbicides used in conjunction with other treatment methods such as “brown and burn” and treatment maintenance. The Proposed Program also has a greater number of herbicide treatment projects (75) than any of the Alternatives (68 more than Alternative 1, 75 more than Alternative 2, 42 more than Alternative 3, and 57 more than Alternative 4). Thus, based solely on area treated, if the cumulative effect contribution of herbicide treatments in the Proposed Program is negligible or less than significant at the scale of a bioregion, then that finding would also apply to the Alternatives.

Determination Threshold Applicable to Wildlife and Botanical Resources

For the purposes of the following evaluation, impacts from the Proposed Program and the Alternatives are considered “significant” within an appropriate time-frame and ecological context if they cause relatively high magnitude, persistent, or permanent changes to:

a) Biological resources protected by local, State, or Federal protection plans, policies, and regulations.
b) Population size, distribution, viability, or recovery potential of a special status species.

Treatments to control or eradicate noxious weeds, to the extent that they are effective, will likely open new microsites for the expansion of adapted special status plants that are already growing in the treatment area, or can spread to it.

The probability of indirect effects of herbicide treatments on special status plants or their habitats is low, but spray drift, wind erosion, surface or subsurface transport, accidental spills, or a combination of these could damage or kill individual plants and unknown populations. This is unlikely for clopyralid treatments under the Proposed Program due to protections provided by LCs 3 and 5 and MMRs 5, 6, and 11 through 16.

Invasives

Many of the noxious weeds that are aggressively invasive are adapted to disturbed sites with little or no shade. Conversions of shrubfields to rangeland, or even for wildlife habitat improvement, will generally only be done by mechanical, hand, or prescribed fire or herbivory treatments. But herbicide treatments following the initial treatments will effectively prevent the regrowth of shrubs and perpetuate the microsite conditions that favor the establishment and spread of most species of noxious weeds.

Herbicide maintenance treatments in shaded fuelbreaks in forest environments are not common, but may become more so if vegetation treatment funding levels decrease. In many locations in California shaded fuelbreaks are being established along road right-of-ways. Road openings provide abundant sunlight, which enhances the establishment and growth of new plants and the regrowth of sprouting species cut during fuelbreak establishment. To remain effective, these fuelbreaks will need to be maintained, which can be done cheaply and effectively using herbicides applied by backpack sprayers or from vehicles.

However, some studies indicate that repeated herbicide treatments, by controlling selected species but not others and by creating favorable seedbeds, create microsites favorable to the invasion of noxious weeds. It is known that road openings are conducive to the spread of windborne seeds of such species as star thistle and pampas grass. So herbicide treatments of roadside shaded (or unshaded) fuelbreaks could result in invasion, reinvasion, or spread of noxious weeds found in the area.

Herbicide treatments to control or eradicate noxious weeds, to the extent that they are effective, will likely open new microsites for the expansion of adapted native plants that are already growing in the treatment area, or can spread to it. To the extent that native plants are able to reoccupy and hold disturbed sites, there will likely be a reduction in the population of noxious weeds.

Since clopyralid is primarily used to control invasive, broadleaved plants, it is likely to reduce local populations of noxious weeds. By so doing it is likely to enhance populations of native plants.

Cumulative Effects to Aquatic and Riparian Resources

The following section evaluates potential cumulative effects to ***aquatic resources and riparian ecosystem function*** *arising from implementation of the Proposed Program or any alternatives*

With the exception of large point sources of pollution such as mine sites, it is highly unlikely that watersheds supporting listed species or waterbodies designated as impaired relative to beneficial uses are the product of a single land use associated impact in time. These watersheds and status of the resource values they support are therefore, by definition, the product of the cumulative effect of a variety of historic and contemporary land use practice effects and the rate of ecosystem recovery. The objective of the VTP PEIR cumulative effects analysis is to assess the likelihood that effects remaining after implementation of VTP projects and required management and mitigation measures will result in any impact greater than a negligible or deminimus contribution when assessed at the scale of the bioregion.

A large number of environmental variables influence the structure and function of aquatic and riparian systems. Working landscapes generally exhibit a wide range of conditions and are the result of historical and contemporary practices. Other lands may exhibit minimal disturbance with little or no evident effects to aquatic and riparian resources values. Within forest and rangelands, major concerns vary by watershed and are typically assessed as “limiting factors,” or inputs to aquatic and riparian systems that limit the ability of the ecosystem to function at a level that produces desired values and products. These factors include: sediment input; heat input related to streamside shading, large woody debris recruitment and delivery, streambank stability, condition of headwater environments, and forest canopy nutrient input to stream ecosystems. Cumulative effects significance criteria were developed for each of these areas and are addresses below. Other water quality related issues that also influence the aquatic environment and riparian resources and associated significance criteria are addressed elsewhere in this chapter as well as in PEIR Chapter 4 (*Environmental Setting*) and Chapter 5 (*Impact Evaluation*).

Little comparative baseline data is available to address long-term amphibian population trends in the western United States and California. True frog and toad species have exhibited the most significant declines. Forty percent of the toad species (four of ten) and 88 percent of the native frog taxa (seven of eight) have been removed from at least 45 percent of their historic California distribution. The documentation of an entire frog fauna declining in a large, diverse region is unprecedented. It is likely that a number of different factors are contributing to the documented declines. One possible explanation suggests that the long-term cumulative effects of multiple factors, where natural low points in amphibian population cycles synergize with widespread environmental alterations (e.g., urban development (loss of habitat), extended drought, changes in UV-B radiation levels, chemical pollutants and pesticides, predation by and competition with non-native species, and disease) will create extinction events. Species occurring in aquatic habitat types such as springs, seeps, marshes, and small headwater streams are at the greatest risk for continued population decline. Degradation and reduction of aquatic habitats has occurred statewide but some regions have experienced greater levels of habitat loss.

The status of anadromous salmonid populations and their habitat can be taken as one measure of change in aquatic and riparian resource health. Annual estimates of salmonid population levels exhibit marked variation due to a large number of interacting environmental conditions. These include specific stream habitat availability to accommodate freshwater life history requirements, water quality and availability, rainfall pattern as an influence on stream flow and juvenile migration rate, oceanic conditions during early residence, level of commercial and recreational harvest, and historic and current land use activities (e.g., agriculture, water diversions, dispersed recreation, off-highway vehicle use, timber management, mining, grazing, and urbanization). These and other environmental conditions have resulted in long-term downward trends in population for specific salmonid stocks and for some, formal listing under the California and/or federal Endangered Species Act.

Regional Water Quality Control Boards (RWQCBs) are required to identify waterbodies with impairments to beneficial uses, under section 303(d) of the Clean Water Act, using a method termed Total Maximum Daily Loads (TMDLs). This process identifies miles impaired, pollution types, and pollution sources. The RWQCBs then develop implementation plans to improve water quality. A review of the 2010 TMDL impairment lists reveals that California has over 26,000 miles of impaired streams. This represents about 14 percent of the total miles of streams and rivers in California. Impairment information for RWQCB watersheds provides a description of the cause of pollution that result in impairment. Most watercourses have many different potential causes and include silviculture, rangeland grazing, and agriculture as at least one of the causes of impairment (Table 6.4.6). The high percentage of impairments identified as unknown indicates uncertainty in identifying nonpoint pollution sources

Over 60 percent of the impaired waterbodies in the North Coast Region list silviculture as one of the causes of pollution. Rangeland grazing activities are one listed cause of impairment on approximately 42 percent of the impaired waterbodies in the Lahontan RWQCB region (Sierra Nevada Range).

Table 6.4.6
Sources of Non-Point Pollution in California's Impaired Lakes, Wetlands, and Rivers, 2010

SOURCE CATEGORY	Rivers & Streams	Lakes & Waterbodies	Freshwater Wetlands
Agriculture	67,925	1,343,575	76,643
Agriculture-grazing	2,490	925	-
Pasture Grazing-Upland/Riparian	3,038	349,986	-
Range Grazing-Upland/Riparian	10,886	5,394	-
Atmospheric Deposition	477	2,320	-
Construction/Land Development	14,045	1,271,815	62,590
Groundwater Related	775	703,325	3,045
Habitat Modification	74,165	98,874	-
Hazardous Waste Sites And Storage	0	658,128	-
Hydromodification	84,348	16,075	-
Industrial Activities (Oil)	49	1,232,998	-
Industrial Wastewater	5,595	738,044	-
Marinas And Recreational Boating	12	135,184	-
Miscellaneous	5,281	673,136	-
Municipal Wastewater	8,814	336,763	-
Natural Sources	21,522	1,288,535	62,591
Other Runoff	2,879	385,677	-
Recreation Areas And Activities	424	393,975	-
Resource Extraction	18,183	628,675	3,045
Sediment	42	279,524	-
Silviculture	41,460	297,500	-
Source Unknown	27,076	1,625,806	11,031
Unpermitted Discharges	361	163,325	-
Unspecified Nonpoint Source	30,650	3,078,228	62,590
Unspecified Point Source	3,428	1,129,091	-
Urban Runoff	8,785	1,658,526	-
Waste Storage And Disposal	3,341	60,859	-

* Most waterbodies have more than one source of pollution. Therefore miles impaired by each pollution source do not add up to total miles impaired. See Sections 4.4 and 5.4 for additional information on water quality.

6.4.11h Cumulative Effects Potential – Criterion 1H

Substantial alteration of sediment inputs to the aquatic environment or floodplain and riparian connectivity.

Vegetation management activities in upland environments have the potential to alter watershed conditions by changing the quantity and size distribution of sediment. These alterations can lead to stream channel instability, pool filling by coarse or fine sediment, channel aggradation, increased turbidity, or introduction of fine sediment to spawning gravels. Stream sedimentation can result in significant effects to aquatic habitat and in turn on fish and other aquatic species populations.

Fine sediment delivery to streams can be reduced significantly by streamside buffer strips. The ability of riparian buffer strips to control sediment inputs from surface erosion depends on several site characteristics, including the presence of vegetation or organic litter, slope, soil type, and drainage characteristics. These factors influence the ability of buffer strips to trap sediments by determining the infiltration rate of water and the velocity of overland flow. In addition, activities within the riparian zone that disturb or compact soils, destroy organic litter, or remove large down wood can reduce the effectiveness of riparian buffers as sediment filters (Spence et al., 1996). Burning within the riparian zone is one such action that can reduce or diminish buffer effectiveness in the short term until a new duff and vegetation layer redevelops. Although fires are not currently prescribed in riparian buffers, incidental burning could occur within them if adjacent prescribed burns move into the riparian zone.

Sediment budgets and erosion studies have shown that sediment sources are not distributed uniformly across a watershed. The most predominant sources often represent a relatively small portion of the watershed. For the Van Duzen River basin, Kelsey (1980) attributed 50 percent of the sediment budget to six percent of the drainage area. Lewis and Rice (1991) reported an average harvest area erosion of 1,100 cubic meters (m^3) per square kilometers (km^2) based on measurement of erosional features. Their study noted that most sediment yield from harvest areas came from critical sites occupying a small portion of the landscape.

Erosion from forest roads can be a persistent source of sediment in a watershed. For example, a sediment budget developed as part of the management plan for the Jackson Demonstration State Forest (JDSF) estimated the average sediment yield for JDSF to be 856 tons/mi^2/year for the period from 1958-1997 (CAL FIRE, 1999). Road related surface erosion and landsliding were the dominant sources accounting for 74 percent of the sediment budget. Background surface erosion was low, suggesting that in undisturbed forests surface erosion plays a minor role in sediment delivery. A detailed sediment budget for Freshwater Creek produced similar results (CAL FIRE, 1999). From 1988-1997, the average sediment input rate was estimated to be 420 tons/mi^2/year. Management activities were shown to be a major source of the sediment budget. Surface erosion from roads was the largest contributor of management related sediment (59 percent), followed by road related landslides (29 percent), and smaller inputs for harvest related landslides and surface erosion. Sediment inputs from natural sources represented more than a third of all sediment inputs over the 10-year period, but were highly variable among sub-basins.

Cumulative Effects Analysis

Road networks in working landscapes are often extensive and difficult to maintain. Recent studies suggest that the connectivity of roads to stream channels increases sediment delivery and affects runoff processes. With forest roads, the highest erosion rates tended to be associated with the initial road construction period overlapping with major storms. However, a high incidence of landslides (mass wasting) is also correlated with steep slopes, unstable soils, and road location and design. Controlling road drainage and avoiding construction of roads on sidecast are shown to prevent fill failures and major debris torrents. Less erosion is observed with improved road design as well as location and roadside erosion control practices. Where forest roads cross streams, a culvert is the typical structure used to pass the stream flow under the road. When such culverts are sized too small, they may impede storm flows and associated debris. If they do, water will back up and may eventually overtop the road and erode all or part of the road surface and fill. This development results in a large input of sediment to the stream.

Forest roads can be designed to significantly minimize erosion and downstream sedimentation in a cost effective manner. Low maintenance, low impact roads can be constructed on forests and rangelands (Weaver and Hagans, 1994). How road systems are built and managed has changed dramatically in the past two decades due to improved awareness of road effects on watershed health, along with heightened regulatory scrutiny for clean water and endangered aquatic species (Cafferata et al., 2007). National forest managers, for example, conducted a thorough roads analysis to determine the risks and opportunities for each road, especially the effect on water quality (Gucinski et al., 2000). The California Forest Practice Rules (FPRs) for roads have evolved to require increasingly stringent standards for roads associated with timber harvest on non-federal lands. Some low value roads are being “decommissioned,” meaning permanently removed from the transportation network. Timberland and ranch managers are learning and applying better practices. Because of all of the above, forest roads today are not all created or managed equally in California, and their impact on water quality varies tremendously.

A variety of ecological relationships exists between riparian zones and, when present, the adjacent floodplain forest. Floodplains may act as both sources and sinks of organic material, coarse woody debris, and sediment. Organic materials within floodplains are processed into forms that are more easily transported and utilized by stream biota and during periods of high flows, these areas also serve as refugia for fish species, particularly the young age classes in overflow channels. Riparian and floodplain buffer widths necessary to maintain these values are dependent on site specific characteristics and flood magnitude (Cafferata et al., 2005). In general, the flood prone zone includes riparian forests that occur on floodplains and low terraces along channels that migrate over their valley floors.

Determination of Significance – Criterion1H

With project level management and mitigation measures in place and as assessed at the scale of the bioregion, the cumulative effects of VTP treatments and related activities on watercourse sediment levels are expected to be negligible or immeasurable. New roads will not be constructed and riparian buffer strips will be required. The cumulative effects are considered less than significant and no further mitigation additional to that implemented at the scale of the project is required.

6.4.11i Cumulative Effects Potential – Criterion 1I

Short or long-term reduction of large woody debris recruitment and delivery potential.

Large woody debris from coniferous trees is an important determinant of stream structural complexity particularly in areas where geology and topography do not provide for other instream structural elements such as boulders, in the Coast Ranges for example. Numerous studies have shown that large wood is an important component of fish habitat (Swanson et al., 1976; Bisson et al., 1987). Trees entering stream channels are critical for sediment retention (Keller and Swanson, 1979; Sedell et al., 1988), gradient modification (Bilby, 1979), structural diversity (Ralph et al., 1994), nutrient production (Cummins, 1974), and protective cover from predators.

The potential for trees to enter a stream channel from tree mortality, windthrow, and bank undercutting in the riparian zone is mainly a function of slope distance from the stream channel in relationship to tree height. As a result, the zone of influence for large wood recruitment is determined by specific stand characteristics rather than an absolute distance from the stream channel or floodplain. Slope and prevailing wind direction are other factors that can affect the amount of large wood recruited to a stream (Spence et al., 1996).

May and Gresswell (2003) examined the relative contribution of processes that recruit and redistribute large wood in headwater streams. Stream size and topographic setting strongly influenced processes that delivered wood to the channel network. In small colluvial channels draining steep hillslopes, processes associated with slope instability and windthrow were the dominant means of large wood recruitment.

Reid and Hilton (1998) documented wood recruitment source distances for a steep headwater second growth coast redwood watershed. They reported that about 90% of the instances of large wood input occurred from tree falls within 115 feet (35 m) of the channel in un-reentered second growth redwood/Douglas-fir forests in the North Fork of Caspar Creek, located in western Mendocino County.

The Forest Ecosystem Management Assessment Team (FEMAT, 1993) concluded that the probability of wood entering the active stream channel from greater than one tree height is generally low. Two widely used models of large wood recruitment also assume that large wood from areas outside one tree height seldom reaches the stream channel (Van Sickle and Gregory 1990; Robison and Beschta, 1990). Additional studies support the contention that most large wood is recruited from within 20 m (66 ft) to 40m (130 ft) of the channel bank. For example, Benda et al., (2002) reported that in the absence of landsliding, wood recruitment in both old-growth and second-growth. Humboldt County study sites originated from within 20 to 40 m of the stream. The four main input mechanisms for their second-growth forest sites in the Van Duzen River watershed included bank erosion, mortality, landsliding, and anthropogenic (or logging related), and averaged 18%, 21%, 13%, and 50%, respectively.

The potential size distribution of large wood is also an important factor when considering the appropriate activities in buffer strips relative to large wood potential recruitment. Larger pieces of wood form key structural elements in streams, which serve to retain smaller debris that would otherwise be transported downstream during high flows (Murphy, 1995). (Spence et al., 1996). The size of these key pieces is approximately 12 inches or more in diameter and 16 feet in length for streams less than 16 feet wide and 24 inches or more in diameter and 39 feet in length for streams greater than 66 feet wide (Bisson et al., 1987). As a result, riparian management zones must ensure not only an appropriate amount or volume of wood, but wood of sufficient size to serve as "key pieces".

Coniferous large wood significantly outlasts deciduous large wood in the stream system (Harmon et al., 1986; Grette, 1985). Simply setting aside buffers of second-growth hardwoods does not provide optimal large wood input over the short term, because unassisted recovery of these areas to pre-logging coniferous large wood recruitment levels may take 100 to 200 years.

Land management and VTP activities that influence tree growth rate, stand density, and mortality rate will determine recruitment of aquatic large wood debris (LWD) (>10cm in diameter and >1m in length; Naiman et al., 2002). Ultimately, a sustained balance must be established between forest stand development through phases of stem exclusion (natural tree mortality and adjustment of stand tree density) or periodic pre-commercial/commercial thinning and the rate at which trees of a desired species and size can be recruited to the aquatic environment through windthrow, fire, lateral bank undercutting, or other means of tree mortality. These riparian forest stand composition variables are further influenced by site specific variables such as existing forest stand structure and composition, soil productivity, influence of competing vegetation, stream size and ability to transport LWD material, and current LWD loads and residence time.

VTP thinning in conjunction with other land management actions conducted in the riparian zone have the potential to either enhance or diminish development and recruitment of LWD to the aquatic environment depending on silvicultural prescription applied, degree of impact to existing trees, and the ecological variables previously described. VTP management practices which may influence aquatic LWD development and recruitment potential are not readily assessed at the scale of the bioregion. Projects with that potential are expected to be uncommon, small in extent, and distributed over a wide area.

Wildfire consumes debris jams, key pieces and reduces overall wood volume, while post wildfire increases in stream discharge increase transport and accumulation of existing LWD (Berg et al., 1998). To the degree that VTP projects reduce the frequency, extent or intensity of wildfire, aquatic LWD feature presence is likely benefited.

Determination of Significance – Criterion 1I

With project level management and mitigation measures in place and as assessed at the scale of the bioregion, the cumulative effects of VTP treatments and related activities on aquatic large woody debris recruitment and delivery mechanisms are expected to be negligible or immeasurable. The cumulative effects are considered less than significant and no further mitigation additional to that implemented at the scale of the project is required.

6.4.11j Cumulative Effects Potential – Criterion 1J

Substantial reduction in stream bank stability

Streambank erosion is a natural process that occurs sporadically in forested and nonforested watersheds (Richards, 1982). Under natural conditions, this process is part of the normal equilibrium of streams. The forces of erosion (water), resistance (root strength and bank material), and sediment transport maintain an important balance. Human activity can accelerate streambank erosion.

Cumulative Effects Analysis

The roots of riparian vegetation help bind soil together, which makes streambanks less susceptible to erosion. Riparian vegetation can also provide hydraulic roughness elements that dissipate stream energy during high or overbank flows, which further reduces bank erosion. In most cases, vegetation immediately adjacent to the stream channel is most important in maintaining bank integrity (FEMAT, 1993); however, in wide valleys with shifting unconfined stream channels, vegetation throughout the floodplain may be important over longer periods.

Riparian vegetation also can provide hydraulic elements that dissipates stream energy during high or overbank flows, which further reduces bank erosion. Although there are limited data quantifying the effective zone of influence relative to root strength, FEMAT (1993) concluded that most of the stabilizing influence of riparian root structure is probably provided by trees within 0.5 potential tree height of the stream channel. Overall, buffer widths for protecting other riparian functions (e.g., large wood recruitment and shading) are likely adequate to maintain bank stability if they are performing most of those functions.

Harvesting of trees adjacent to streams can lead to a loss of root strength, thus making streambanks more susceptible to erosion. Important alterations of the system components that may result from timber harvesting activities include: 1) removing trees from or near the streambank; 2) changing the hydrology of the watershed; and 3) increasing the sediment load, which fills pools and contributes to lateral scour by forcing erosive stream flow against the streambank (Pfankuch, 1975; Cederholm et al., 1978; Chamberlin et al., 1991). With respect to the northern California coast, however, it is noteworthy that redwoods, the dominant conifer along many streams, resprout following harvesting. As a result, decreases in redwood root strength are typically lower than in other forest types.

Reid et al., (2010) reported that in-channel erosion (including streambank erosion) associated with hydrologic change is an important source of postlogging sediment at Caspar Creek, where logging increased winter peak flows. Common sediment-control measures, such as use of riparian buffer strips and reduction of road surface erosion, are not effective for reducing sediment input from this source. VTP practices, however, are not anticipated to significantly increase winter peak flows, due to low prescribed burn intensities and lack of clearcutting watersheds. Robichaud et al., (2010) reported that if areas are burned at low severity, the potential for increasing erosion rates and peak flows is relatively small.

VTP management practices which may influence streambank stability are not readily assessed at the scale of the bioregion. Streambank erosion is largely a localized process and determining relative contribution of effects that result in a significant cumulative effect contribution and assessed at the scale of a bioregion is not possible

Wildfire consumption of upland vegetation and post wildfire increases in stream discharge can result in streambank instability depending on stream size, wildfire impact on streamside vegetation, and other environmental variables. To the degree that VTP projects reduce the frequency, extent or intensity of wildfire, streambank stability is likely benefited.

Determination of Significance – Criterion 1J

VTP projects with the potential to make a cumulative effect contribution to existing areas of streambank instability are expected to be uncommon, small in extent, and distributed over a wide area. Increase in stream discharge as a result of watershed disturbance requires significant change in extent of vegetation cover (Lewis et al., 1998, Reid et al., 2010) and would likely exceed thresholds for consideration of a VTP project. With project level management and mitigation measures in place and as assessed at the scale of the bioregion the cumulative effects of VTP treatments and related activities on streambank stability are expected to be negligible or immeasurable. The cumulative effects are considered less than significant and no further mitigation additional to that implemented at the scale of the project is required.

6.4.11k Cumulative Effects Potential – Criterion 1K

Reduction of headwater or spring/seep environments to function as amphibian habitat; or provide sediment retention, nutrients, and woody debris to downstream environments.

Headwater streams and drainages (Forest Practice Rule Class II and III) are areas that contribute to stream ecosystem function. These areas can represent 60-80% of total channel length in mountainous terrain (May and Gresswell, 2003a). These small streams contribute structural components such as large woody debris, spawning gravels and stream substrate, and invertebrate and detritus inputs. These sites also contribute to water quality and provide for storage of potentially deleterious fine sediment. Similarly, they can have a strong influence on the rates of sediment and wood delivery to larger watercourses, and consequently, habitat value for a variety of aquatic and semi-aquatic vertebrates and other biota (Welsh et al., 1998). Management approaches aimed at restoration and management of watershed processes, rather than individual habitat characteristics, may be more effective in developing complex stream channel structure (May and Gresswell, 2003b). The underlying assumption is that movement toward restoration of natural processes and levels of sediment production, large woody debris recruitment, and other stream function processes, will be positive for stream biota.

Disturbance as an Influence on Headwater Stream Ecosystem Structure and Function

The structure and function of stream ecosystems has been extensively studied and reinforces the concept of the “river continuum” (Vannote et al., 1980). That being that energy and organic material inputs to stream processes change in a predictable way along the stream course from headwaters to downstream reaches. A variety of land uses, including timber harvest and forest management, can influence background erosion and sedimentation regimes, recruitment of large woody debris and other ecological processes. The delivery, time in residence, and transport of these additional sediments and woody debris influence stream channel conditions and associated biota. Change in vegetation in the vicinity of headwater streams can markedly alter the function of these stream types and those larger stream systems supported. Change in the efficiency of the channel to recharge groundwater, meter trapped sediments and water flow, and process organic material and other nutrients for use by aquatic biota downstream can be expected. Past management practices that reduced local sources of wood and rate of wood recruitment increase the relative importance of wood contributed by debris flows in colluvial tributaries where this means of recruitment occurs. Most debris flows in the northern California Coast Ranges originate from zero-order colluvial-filled hollows. The principle influence of vegetation along Class III channels on the mobilization of debris is the presence of in-channel large trees that could slow or stop mobilized sediment and debris under some circumstances or contribute large wood at other times. Because debris flow potential is not universal, WLPZ boundaries cannot be used as a surrogate to actual site inspection for potential zones of failure (T. Spittler, pers. comm. 10/28/04).

Type disturbance has markedly different results on the structure and function of stream and associated riparian ecosystem processes. For example, floods, fire, and mass wasting events are generally less frequent and result in large localized changes to stream system processes, whereas, timber harvest, land conversion, agricultural and urban development are more frequent, but the area effected can be smaller in spatial extent. Treatment methods associated with the VTP and other similar land management activities can alter headwater stream system function and habitat quality. Significant vegetation removal by any means can release perched sediment deposits, alter habitat quality by filling interstitial spaces in the streambed, and reduce large woody debris and consequently volume of sediment storage capacity. In general, the topographic placement of many headwater stream and seep environments prevent or make impractical vegetation treatment by mechanical means. Similarly, where these environments are accessible to other VTP methods they are effectively avoided or excluded from treatment during project level planning and implementation. Prescribed fire as a vegetation treatment method has the greatest potential to negatively impact these stream environments by removing woody debris, releasing stored sediments and altering vegetation cover, habitat conditions, and microclimate.

Headwater Habitat Relationships.

Because of the small size of headwaters and close connection with uplands, these areas are readily influenced by adjacent land uses. Species that inhabit headwater environments can be especially vulnerable to habitat alteration. These species, amphibians and other taxa, generally achieve higher population densities in headwater habitats. In addition, individual species inhabiting headwater habitats generally exhibit low levels of vagility (mobility) sometimes spending their entire life cycle in a few square meters of habitat (Sheridan and Olson, 2003). Recolonization of suitable vacant habitat may require extensive periods of time or, lacking movement into vacant habitat, result in local population extirpation.

Headwater stream reaches, lacking fish populations, provide areas with little or no fish predation pressure to the benefit of several aquatic and semi-aquatic amphibians. Amphibians that breed primarily in stream habitats represent a large component of stream biomass and in the Pacific Northwest may exceed fish in both numbers and biomass (Hawkins et al., 1983). Welsh and Ollivier (1998) examined the effect of sediments on aquatic amphibian densities in coast redwood. Three species were sampled in numbers sufficient to be informative: tailed frog (*Ascaphus truei*, larvae), Pacific giant salamander (*Dicamptodon tenebrosus*, paedomorphs and larvae), and southern torrent salamander (*Rhyacotriton variegatus*, adults and larvae). Densities of amphibians were significantly lower in the streams impacted by sediment. While sediment effects were species-specific, reflecting differential use of stream microhabitats, the shared vulnerability of these species to infusions of fine sediments was probably the result of their common reliance on interstitial spaces in the streambed matrix for critical life requisites, such as cover and foraging. Studies by Diller and Wallace (1996) and Wilkins and Peterson (2000) indicate persistence of headwater amphibians in managed forests and demonstrate the need to focus on importance of abiotic features such as parent geology, topography and channel characteristics to predict species distribution and responses to disturbance.

Determination of Significance – Criterion 1K

Identifying the cumulative downstream effects on biota that result from modifications along headwater streams is recognized as a research gap (MacDonald, L. and D. Coe, 2007). Headwater stream ecosystems vary greatly in terms of how they function both locally and at a basin scale. This variability manifests itself in differences in channel morphology, hydrologic regime, and riparian and biological characteristics. The variability of these small headwater streams therefore challenges the manager's ability to predict process and management effects at a large scale (MacDonald, L. and D. Coe, 2007). Several headwater stream protection measures are described in the project development checklist and include equipment limitation and exclusion zones and stipulations on the use of prescribed fire. With project level management and mitigation measures in place and as assessed at the scale of the bioregion the cumulative effects of VTP treatments and related activities on headwater stream and seep environments, ecological processes, and associated biota are expected to be negligible. The cumulative effects are considered less than significant and no further mitigation additional to that implemented at the scale of the project is required.

6.4.11l Cumulative Effects Potential – Criterion 1L

Substantial reduction in forest canopy nutrient input to stream systems.

Vegetation management practices can lead to changes in leaf litter distribution and dynamics in upland and riparian areas, which in turn affect availability in streams. Harvest intensity (i.e., the proportion of forest canopy removed) and cutting frequency affect the rate of nutrient removal from the system (Beschta et al., 1995).

Detritus enters a stream primarily by direct leaf or debris fall, although organic material may also enter the stream channel by overland flow of water, mass soil movements, or shifting of stream channels. Few studies have been done relating litter contributions to streams as a function of distance from the stream channel; however, it is assumed that most fine organic litter originates within 100 feet or approximately 0.5 tree height from the channel (FEMAT, 1993). In most cases, however, buffers designed to protect most large wood recruitment would likely ensure nearly 100 percent of detrital input (Spence et al., 1996). Spence et al., (1996) concluded that a buffer width of 0.75 of a site-potential tree height is needed to provide full protection for litter inputs.

Stand age significantly influences detrital input to a stream system. Detrital input from outside the stream channel was estimated to be two times as high in old-growth forests as in either 30- or 60-year-old forests (Richardson, 1992) and could be as much as five times as high in old-growth forests as in recently clearcut forests (Bilby and Bisson, 1992). However, reduced levels of detrital input into streams attributable to streamside timber harvesting is somewhat offset by concomitant increases in detritus production within stream channels (primarily dead algae and other aquatic plant debris). Reduced riparian forest canopy increases light levels and, therefore, the production of algae. The abundance and composition of detritivore (macroinvertebrates that process detritus) assemblages in streams are determined largely by the plant composition of riparian zones (Gregory et al., 1991). Therefore, changing the stand composition may alter the macroinvertebrate composition.

In the North Fork of Caspar Creek within California's redwood region, most macroinvertebrate and algal variables increased significantly after logging. Macroinvertebrates increased because of increased stream algae. Algae increased because of increased light, water temperature, and nutrients. Logging effects on the North Fork of Caspar Creek biota were often not dramatic because forest practices minimized the effects. The three most important practices that ameliorated the effects were the presence of riparian buffer zones, absence of roads near the stream, and use of cable yarding which minimized soil disturbance (Bottroff and Knight, 1996).

Determination of Significance – Criterion 1L

With project level management and mitigation measures in place and as assessed at the scale of the bioregion the cumulative effects of VTP treatments and related activities on forest canopy nutrient input to stream systems is negligible. The cumulative effects are considered less than significant and no further mitigation additional to that implemented at the scale of the project is required.

Summary

Contribution of the VTP to existing, past or expected future land disturbance activities at a level that would result in a significant cumulative effect or any effect above a deminimus level is not expected to occur. Therefore no additional mitigations to address cumulative effects to aquatic resources or riparian function are required beyond those identified in Chapter 5.

Landscape constraints and Minimum Management Measures identified for Wildlife (Section 5.5.2), Aquatic Resources (Section 5.5.1) and Water Quality and Quantity (Section 5.7) will, in the aggregate, reduce cumulative, direct and indirect effects to aquatic resources and riparian function to a less than significant or deminimus level as assessed at the scale of the bioregion. Reduction in the occurrence of high severity wildfire as a result of vegetation treatment technique application is expected to provide additional benefits to aquatic resources although to a degree not presently determinable.

The statewide acreage ten-year average proposed for treatment within the VTP ranges from 470,000 acres in Alternative 1 to 2,500,000 acres for the Proposed Program and Alternatives 2 and 3, which is per decade between 1% and 6% of the 37-million acre program area. This means that there will be very few projects spread over many acres, and the probability of numerous projects occurring in a single watershed is very low, even over 10 years. The treatment types, proportions by bioregion and percent of watersheds in varying disturbance classes are listed in Chapter 5 for the Program and Alternatives.

Assuming that the percent area treated in a watershed is proportional to the percent of stream miles directly affected in a watershed allows use of Table 5.0.7 to roughly estimate the proportion of stream channels directly affected from implementing the Program and Alternatives 2 and 3. On an annual basis, 88% of watersheds in the state receive no treatment and 98% of watersheds have less than 10% of their area (proportional to stream length) treated (see Chapter 5). Alternatives 1 and 4 treat even less area (Table 5.0.8).

Similarly, when all land disturbing activities are summed by bioregion (Table 6.2.11), the relative contribution of VTP projects to similar land disturbing activities provides a relative impact contribution perspective.

The majority of the VTP will utilize prescribed fire to meet vegetation treatment objectives (115,000 acres of the 217,000 acre ten-year average in the Proposed Program (Table 2.4)). Most of California’s ecosystems have evolved with recurring fire. The plant communities, topography, elevation, and climatic conditions influence the “fire regime,” the frequency and intensity of fire for a specific plant community (McKelvey et al., 1996). In turn, the extent and intensity of fire influence ecological processes, shapes plant communities, and affects biological resources. A continuum of fire regimes has evolved in various plant communities. For example, historically, ponderosa pine-dominated mixed conifer forests of the Sierra had a fire regime of frequent, low- to moderate-intensity fires. Before fire suppression, such a fire regime along with other conditions maintained a plant community of large, well-spaced trees. At higher elevations, lodgepole pine communities evolved with less-frequent but more-severe fires (McKelvey et al., 1996). Similarly, across the West, including in the Sierra Nevada and Modoc Plateau, aspen are in decline. Heavy livestock grazing reduced fire frequency, historically high numbers of foraging deer in the 1950s and 1960s, the drying of meadows, and conifer encroachment have all contributed to the decline of aspen stands. Less-frequent fire over the past century has limited aspen regeneration. The results of prescribed fires in the Sierra have shown excellent ecological benefits (Keifer et al., 2000). However, while the increasing use of prescribed fire is considered a necessary tool to restore ecosystems and reduce the risk of catastrophic wildfire, it is currently applied to too few acres in certain bioregions such as the Sierra. Returning fire to fire adapted plant communities presents great challenges. The fire threat to people and expanding communities, excessive fuel loads created by fire suppression and past management practices, effects on air quality and conflicts with clean-air laws, and liability all impose difficult constraints on the increased use of prescribed fire. Even with the land managers best efforts to reduce fire conflicts and risks, in many areas, reintroducing fire at the scale of the project will not be practical or politically possible, at least as a first treatment. Alternative vegetation treatment methods may need to be employed at potentially greater cost and with fewer ecological benefits.

Cumulative Direct Effects of Herbicides to Aquatic and Riparian Resources

Section 5.17 summarizes the environmental and human health effects arising from herbicide use under the Proposed Program or the Alternatives. This section discusses the cumulative direct effects of herbicide use on wildlife and botanical resources separate from the indirect effects of habitat alteration addressed above. Under the Proposed Program a total of 19,620 acres could be treated annually with lesser acreage treated depending on Alternative (Table 5.17.3). The acreage reported includes the use of herbicides used in conjunction with other treatment methods such as “brown and burn” and treatment maintenance. The Proposed Program also has a far greater number of herbicide treatment projects (75) than any of the Alternatives (68 more than Alternative 1, 75 more than Alternative 2, 42 more than Alternative 3, and 57 more than Alternative 4). Thus, based solely on area treated, if the cumulative effect contribution of herbicide treatments in the Proposed Program is negligible or less than significant at the scale of a bioregion, then that finding would also apply to the Alternatives.

Herbicides will be potentially used in the Proposed Program and Alternatives 1, 3, and 4 to treat only terrestrial vegetation and only by applications from the ground While aquatic environments are not specifically buffered from spray projects, other than through court orders applicable to specific areas and chemicals, specific LCs (3 and 5) and MMRs (5, 6, 11 through 16) require buffers to protect special status aquatic species. While Landscape Constraint 1 does not preclude herbicide treatments within Class I or II watercourse buffers, it does require vegetation within and adjacent to Class III watercourses to be retained, as feasible, to protect water quality, which will preclude herbicide treatments. Although Landscape Constraint 3 permits herbicide treatments of wet meadows, marshes, vernal pools, and other wet areas for habitat improvement, measures necessary to minimize damage to the wetlands are required. Such measures will likely preclude the application of 2,4-D (EHE ester) and may preclude all herbicide treatments.

Determination Threshold Applicable to Aquatic and Riparian Resources

For the purposes of the following evaluation, impacts from the Proposed Program and the Alternatives are considered "significant" within an appropriate time-frame and ecological context if they cause relatively high magnitude, persistent, or permanent changes to:

- Biological resources protected by local, State, or Federal protection plans, policies, and regulations.
- Population size, distribution, viability, or recovery potential of a special status species.

The only herbicide analyzed that is highly toxic to sentient aquatic lifeforms is 2,4-D (EHE ester). One product label (Weed Rhap® LV-6D) prohibits application of this herbicide "directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark." It also prohibits applications "when weather conditions favor drift from the target area." The main mode of 2,4-D (EHE ester) transport offsite is by spray drift (see discussion above and in Appendix F. Drift will be minimized, as only ground spraying methods will be used. 2,4-D (EHE ester) is not likely to travel through groundwater into waterbodies.

In 2005, 13,641 pounds of 2,4-D (EHE ester) were applied on 8,624 acres of forestland where reporting was required (state and private lands) and 394 pounds were applied on 1309 acres of rangeland (2005 PUR). This represents about 16.5% (pounds) and 7.9% (acres) of the total of all forestland herbicides analyzed in the Proposed Program and 2.6% (pounds) and 3.4% (acres) of the total of all rangeland herbicides analyzed. There is no reason to believe that the relative percentage of 2,4-D (EHE ester) potentially applied in the Proposed Program will be less than in the past. Therefore, it can be concluded that about 734 acres of forestland per year and 220 acres of rangeland per year will potentially be treated with herbicide products containing 2,4-D (EHE ester) under the Proposed Program.

The approximate percentage of forestland potentially treated with 2,4-D (EHE ester) in each bioregion is as follows: Sierra Nevada 41%, Sacramento Valley 29%, North Coast 24%, and Modoc and Bay Area 3% each. The approximate percentage of rangeland potentially treated with 2,4-D (EHE ester) in each bioregion is as follows: Central Coast 54%, South Coast 24%, Bay Area 18%, Sacramento Valley and Sierra Nevada 1% each. Adverse effects, if any, from this herbicide would most likely be to aquatic organisms found in forestland applications in the Sierra Nevada, Sacramento Valley, and North Coast Bioregions and in rangeland applications in the Central and South Coast and Bay Area Bioregions.

In summary, with the exception of 2,4-D (EHE ester), the chemicals analyzed and likely to be applied under the Proposed Program are only slightly toxic to practically nontoxic, although no testing has been done on the effects to amphibians of most of the chemicals. At the normal application rates, methods of application (all ground based), and with the LCs and MMRs in the Proposed Program, short term, local effects to individual aquatic species are likely to be negligibly adverse and will most likely be due to improper handling (spills) or disposal of the herbicides. Long term, bioregional or statewide effects to individual aquatic species negligibly are also likely to be negligibly adverse.

Mitigations

1A—None required with implementation of project level landscape constraints, minimum management requirements, and best management practices as assessed at the scale of the bioregion.

1B— None required with implementation of project level landscape constraints, minimum management requirements, and best management practices as assessed at the scale of the bioregion.

1C—As a management measure applied at the scale of the project, assess the likelihood of project scale effects to influence habitat condition of identified landscape scale linkages through coordination with local wildlife agencies.

1D— None required VTP projects will not conflict with conservation plan provisions and may benefit attainment of plan goals and objectives.

1E— None required with implementation of project level landscape constraints, minimum management requirements, and best management practices as assessed at the scale of the bioregion.

1F—Implement snag and down log retention guidelines at the scale of the project and project level checklist.

1G—Where the threat of non-native invasive plant establishment or range increase is substantial, utilize vegetation treatment methods and/or post-project follow-up measures to prevent establishment or where existing, control expansion. Implement procedures to minimize the likelihood of seed or propagule distribution from project equipment.

1H—None required with implementation of project level landscape constraints, minimum management requirements, and best management practices as assessed at the scale of the bioregion.

1I—None required with implementation of project level landscape constraints, minimum management requirements, and best management practices as assessed at the scale of the bioregion.

1J—None required with implementation of project level landscape constraints, minimum management requirements, and best management practices as assessed at the scale of the bioregion.

1K—None required with implementation of project level landscape constraints, minimum management requirements, and best management practices as assessed at the scale of the bioregion.

1L—None required with implementation of project level landscape constraints, minimum management requirements, and best management practices as assessed at the scale of the bioregion.

6.5 Cumulative Effects Summary

The following table provides a comparison of cumulative effects by resources topic and for each alternative.

Table 6.5.1
Summary of Potential Adverse and Beneficial Cumulative Effects at Project or Bioregional Scales of Assessment

	Cumulative Effects Potential for the Various EIR Alternatives*					
	Potential for Significant *Adverse* Cumulative Effects			**Potential for Significant *Beneficial* Cumulative Effects**		
Resource Area	Yes after mitigation (a)	No after mitigation (b)	No reasonably potential significant adverse effects (c)	Yes without mitigation (a)	Yes after mitigation (b)	No reasonably potential significant beneficial effects (c)
Geology and Soils – 2a: increase landslides		X				
Geology and Soils – 2b: increase soil erosion		X				
Wildland Fire Risk and Severity		X		X		
Wildlife and Botanical Resources –1A, 1B: species of concern, habitat, or range				X		4
Wildlife and Botanical Resources—1D: conservation plan objectives		X			X	
Wildlife and Botanical Resources--1C,1E: species movement and population sustainability				X		
Wildlife and Botanical Resources—1F: non-native invasives		X			X	
Wildlife and Botanical Resources—1G: habitat elements		X			X	
Aquatic and Riparian Resources—1H, 1I, 1J: sediment, large woody debris, streambank stability		X				
Aquatic and Riparian Resources—1K: headwater stream processes						
Aquatic and Riparian Resources—1L: aquatic nutrient input						

Table 6.5.1
Summary of Potential Adverse and Beneficial Cumulative Effects at Project or Bioregional Scales of Assessment

	Cumulative Effects Potential for the Various EIR Alternatives*					
	Potential for Significant *Adverse* Cumulative Effects			**Potential for Significant *Beneficial* Cumulative Effects**		
Resource Area	Yes after mitigation (a)	No after mitigation (b)	No reasonably potential significant adverse effects (c)	Yes without mitigation (a)	Yes after mitigation (b)	No reasonably potential significant beneficial effects (c)
Air Resources (Quality)		X	3		X	
Air Resources (Visibility)		X	3		X	
Visual / Aesthetic Resources			X			
Water Resources – 1a: alter flows			X			
Water Resources – 1b: degrade water quality		X				
Recreation Resources		X				
Archaeological and Cultural Resources			X	X		
Noise		X				
Population and Housing		X				
Transportation and Traffic			X			

Note: Unless otherwise stated an "X" in the matrix refers to both the Proposed Program and the Alternatives. The number refers to the Alternatives 1 through 4.

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